PYE'S
SURGICAL HANDICRAFT

A MANUAL OF SURGICAL MANIPULATIONS, MINOR SURGERY, AND OTHER MATTERS CONNECTED WITH THE WORK OF SURGICAL DRESSERS, HOUSE SURGEONS, AND PRACTITIONERS

EDITED BY

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THIRTEENTH EDITION FULLY REVISED
WITH 534 ILLUSTRATIONS

Vel de minimis curat chirurgicus

BRISTOL JOHN WRIGHT & SONS LTD.
LONDON SIMPKIN MARSHALL (1941) LTD

1942

First Edition, September, 1884
Second Edition, October, 1885
Third Edition, July, 1891
Fourth Edition, December, 1899
Fifth Edition, June, 1909
Sixth Edition, October, 1912
Seventh Edition, May, 1916
Eighth Edition, January, 1919
Reprinted, January, 1922
Ninth Edition, December, 1924
Tenth Edition, January, 1931
Eleventh Edition, December, 1938
Twelfth Edition, July, 1940
Thirteenth Edition, September, 1942

PRINTED IN GREAT BRITAIN BY JOHN WRIGHT AND SONS LTD., BRISTOL, ENGLAND

PREFACE TO THE THIRTEENTH EDITION

THIS edition is overdue For the first time in its long career *Pye's Surgical Handicraft* has been out of print for over a year Destroyed with its illustration blocks and a large number of its original illustrations only to be bombed again as publication was near at hand, there have been times when the thirteenth edition seemed fated

I believe that the thirteenth edition will eclipse any previous issues of the work, for experience has taught me that the success of a medical book is dependent, not on luck, but on the energy and care which is bestowed upon it

The combined efforts of my contributors have been magnificent I am positively amazed at the fortitude of the Publishers Cervantes in prison assiduously wrote on scraps of paper which had wrapped his food Touched by such perseverance under heart-breaking circumstances, his warder appealed to the prison governor for some proper paper for his charge "No," said the man of iron, "he works better under difficulties" So must it be with the Publishers

My labours have been lightened by the proof readers, and I wish to record my thanks to Lt-Col John Bruce, F R C S E, Mr M N Matheson, F R C S, and Drs J Boyes, E Emanuel, and B P Royston

HAMILTON BAILEY

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September 1942

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INTRODUCTION

By Hamilton Bailey

It is fifty eight years since *Pye s Surgical Handicraft* first appeared When we reflect that only eight books out of every thousand which are published live for twenty years, and that the life of a book on an ever advancing subject like surgery is very much shorter than the average it is clear that Mr Pye put into the hands of the profession a worl of exceptional merit No less interesting and important is the fact that *Pye s Surgical Handicraft* was one of the very first medical books issued by the present publishers

WALTER PYE
1853 1892

I assumed the editorship in 1938 and I set about my task in a way of which I believe Mr Pye would have approved, I inquired from House Surgeons and Practitioners what they wanted to find in a book of this character

I have continued this policy, but so vast is the horizon of surgery to-day compared with that of fifty years or more ago that without the specialized help of the contributors it would have been impossible for me to have continued to provide what Mr Pye provided—a practical handbook suited to the needs of the reader

SURGICAL HANDICRAFT

CHAPTER I

THE ARREST OF HÆMORRHAGE

By Hamilton Bailey

I. BY DIGITAL COMPRESSION

Because of the fatigue it produces, digital compression cannot be continued for more than ten minutes or a quarter of an hour. Long before that time, however, help may have arrived, or an improvised tourniquet may have been applied.

The position of the hand and finger to be employed will vary, but as a rule the thumb had better be used to make the pressure, and be reinforced if necessary by that of the other hand. The limb must always be raised.

Fig 1.—The control of hæmorrhage from the lip by compressing the coronary arteries

Fig 2.—Compression of the common carotid artery over Chassaignac's tubercle. A, Pomum Adami; B, Cricoid; C, Manubrium.

Arteries of the Head and Neck.—In cases of injury to the scalp, the underlying skull affords an admirable resisting surface for compression.

Bleeding from the lip forms an exception to the rule of making digital compression against bone, for the coronary arteries are best compressed between the fingers and thumbs (*Fig.* 1).

Bleeding from the Tongue.—When hæmorrhage occurs from the posterior part of the tongue Heath's method should be employed. A finger is passed as far back as possible and the tongue is hooked forward on to the mandible.

Common Carotid Artery.—The thumb should be placed over the artery at the level of the transverse process of the sixth cervical vertebra, which is about $1\frac{1}{2}$ inches above the sternoclavicular articulation; pressure should then be made

inwards and backwards In this way the artery is forced away from the jugular vein and vagus nerve, and is compressed against the sixth transverse process (Chassaignac's tubercle) (*Fig* 2)

Subclavian Artery.—The only part of the subclavian artery which can be compressed is the third, this is sometimes difficult and sometimes easy to perform The bone against which it is to be pressed is the upper surface of the first rib, immediately outside the tubercle for the insertion of the scalenus anticus In children or thin people, pressure behind the clavicle downwards and *backwards* (*Fig* 3), at the inner margin of the subclavian triangle, will control the circulation, no matter what the position of the limb and neck may be, but in even moderately fat people it will be necessary to depress the clavicle and shoulder to bring the artery near enough to the surface

Fig 3 —Compression of the third part of the subclavian artery

Various devices, such as the handle of a door key, properly padded, have been devised to effect the necessary compression in obese and muscular individuals

Axillary Artery—The lower half of the second part, and the third part, are tolerably superficial, and can be compressed in the axilla if the arm is raised

Fig 4 —Compression of the brachial artery

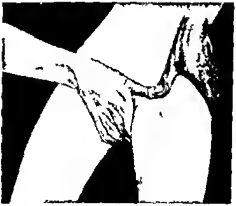

Fig 5 —Compression of the common femoral artery

The pressure is made against the humerus in the same manner as in the brachial (*see below*), and the vessel can be localized quite easily as it crosses to the outer side of the axillary space

Brachial Artery—By reason of the number of accidents to which the upper limb is liable, this artery requires compression more frequently than all the others put together

As the brachial artery is practically subcutaneous in its whole length, it can be compressed readily against the humerus The inner edge of the biceps, which overlaps it in the middle third, is the guiding line for the vessel (*Fig* 4)

Femoral Artery.—The compression of this artery as it lies over the pelvic brim is required frequently In this situation the circulation may be controlled completely by making pressure directly backwards, i e, at right angles to the surface, midway between the pubic symphysis and anterior superior iliac spine (*Fig* 5)

As far as possible pressure on the vein should be obviated, the inguinal glands, too, as they lie parallel with Poupart's ligament, must be avoided, and if they are enlarged, this is sometimes difficult

The line of the *superficial femoral artery* is one taken from the point above mentioned, between the symphysis and anterior superior iliac spine, and the adductor tubercle of the femur When the knee is slightly flexed, and the thigh rotated outwards, firm pressure all along this line will generally succeed in stopping the current of blood, but as the artery gets deeper in its course, more and more force will be required The artery cannot be pressed directly against the bone

Abdominal Aorta—In some cases the digital compression of this artery is not so extremely difficult as is often supposed It can generally be effected in children, and in adults if they are thin, with lax abdominal walls and a bold anterior vertebral curve, and especially in women who are sparely nourished and have borne children

The spot where this compression should be made is a point three quarters of an inch above a line drawn across the abdomen from one iliac spine to the other (the level of the aortic division into the two common iliacs), and a little to the left of the middle line The exact position of the artery should be ascertained before pressure is made, for frequently it is in the middle, or may even deviate somewhat to the right

The digital compression is best and most readily made by the middle and forefinger of one hand, beneath which a small pad of lint should be placed, reinforced by the pressure of the fingers of the other hand

II. BY TOURNIQUETS

Tourniquets are employed (1) To arrest hæmorrhage, or (2) To ensure a bloodless field during certain operative procedures on limbs There is not a better demonstration of the old adage "it does more harm than good" than a badly applied tourniquet

A tourniquet must never be left unreleased for more than twenty minutes If by the end of this time compression is still necessary, the tourniquet should be loosened sufficiently to allow some blood to escape, when it is tightened once again In this way gangrene may be averted

The application of a tourniquet consists of two manœuvres —

1 Elevation of the limb This allows the venous blood to drain away by gravity, and at the same time produces a reflex constriction of the arterioles This latter effect occurs after a period of elevation of about two minutes Lord Lister demonstrated this by the sudden blanching of a limb which occurs when it has been held up for that length of time

2 The application of the constricting agent Of the many patterns of tourniquets available only a few can be described

Samway's Tourniquet—This consists of a length of stout rubber tubing with an anchor-shaped metal clip attached to one end (*Fig* 6) Callander's modification (*Fig* 7) enhances the ease of application

The limb is elevated by an assistant, and at the end of a minute and a half the tourniquet is applied The skin is protected by several layers of towelling

or lint The most important turn is the first, every endeavour should be made to make it as tight as possible The anchor is held against the limb with one hand, while the rubber tubing is passed behind the limb and then stretched to its utmost by the other hand (*Fig* 8) In order to get a good purchase, a fairly short length of the tubing is stretched in this way

Keeping the tube stretched, it is applied to the limb, and when the turn is completed it is gripped by the thumb and index finger of the hand holding the anchor Another two or three turns are similarly obtained, and the free end held by passing it, still stretched, behind the flukes and over the shaft of the anchor (*Fig* 9) Care should be taken to see that the skin is not pinched between the loops This is a useful tourniquet for the thigh, but it should not be employed for the upper limb—the integrity of nerves, especially the radial (musculospiral), is endangered

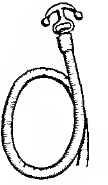

Fig 6 —Samway's tourniquet.

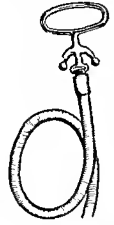

Fig 7 —Callander's modification of Samway's tourniquet

The Pneumatic Tourniquet—Several patterns are available The cuff of a sphygmomanometer is a pneumatic tourniquet A pressure of 200 mm Hg will usually ensure avascularity of the arm without damaging nerves or muscles

Fig 8 —The application of Samway's tourniquet. The first turn.

Fig 9 —The application of Samway's tourniquet Locking the tubing in the anchor

The L. P. L. Tourniquet (*Fig* 10) —The L P L tourniquet is so easy to apply and release that it is possible for the tourniquet to be applied by the patient himself (e g , a wounded airman) By pulling on one end of the stout rubber band the tourniquet tightens automatically The rounded metal bar should lie over the main artery and when the screw is turned considerable direct pressure is exerted on this underlying vessel The release of the tourniquet is effected by approximating the finger grips (A)

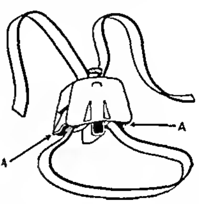

Fig 10 —The L. P L. tourniquet.

Esmarch's Bandage is made of strong, flat rubber, 3 in wide by 6 yd long, with two tapes at one end

The limb is elevated, and after an interval the rubber bandage is wound around the limb from below upwards Each turn of the bandage is fully stretched before being applied to the limb, and each turn should just meet edge to edge or barely overlap the preceding one When the middle of the thigh or arm is reached, several turns are made directly over each other, and the tapes tied If there is still a considerable quantity of the roll left, it is tucked under the last two or three turns (*Fig* 11), instead of unrolling it, so as to act as a pad and apply direct pressure on the femoral or brachial artery

Fig 11 —Esmarch's bandage applied.

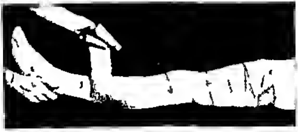

Fig 12.—Beginning below the bandage is removed The major portion of the bandage is unwrapped

Beginning below, the bandage is now unrolled (*Fig* 12) as far as necessary to expose the field of operation There is no danger of the upper part becoming loose if the tourniquet is correctly applied If the turns are made to overlap, difficulty will be encountered in unrolling the bandage

CHAPTER II

RESUSCITATION

By HAMILTON BAILEY and JOHN BRUCE

"*Lateat scintillula forsan*"—'*a small spark may perhaps lie hid*." *This is the motto of the Royal Humane Society, the pioneers of resuscitation of the apparently drowned.*

ARTIFICIAL RESPIRATION

THE best method of artificial respiration is not standardized. The well-known Silvester's method (*Fig.* 13) is the one most commonly adopted. It is certainly the most easily applied in the operating theatre; but for general use on adults, and especially for the apparently drowned, the method of choice is that devised

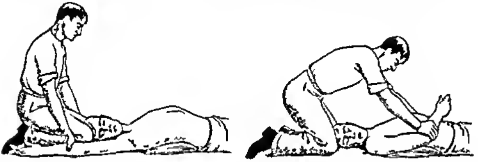

Fig. 13.—Silvester's method of artificial respiration.

by Schafer. In children, rhythmical compression of the upper abdomen and lower ribs is considered to be more satisfactory than any other method. It should be emphasized that the common mistake of the novice in performing artificial respiration is to do so too quickly. Slow forcible movements are best; twelve times per minute is the rate for an adult, and somewhat faster for a child. More rapid speeds do the patient no good and only tire the operator.

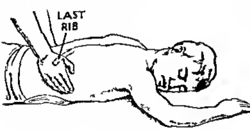

Fig. 14.—Schafer's method of artificial respiration.

Schafer's Method.—Place the patient face downwards on the ground, preferably with a part of a folded coat under the lower chest. Do not lose time in attempting to remove his clothing. Begin artificial respiration as follows:—

1. Place yourself athwart or on one side of the patient's body, in a kneeling posture and facing his head.

2. Place your hands flat over the lower part of the back (on the lowest ribs), one on each side, and gradually throw the weight of your body forward on to

them, so as to produce firm pressure—*which must not be violent*—upon the patient's chest

3 Raise your body slowly, so as to remove the pressure, but leaving your hands in position

4 Repeat this forward-and-backward movement every four or five seconds (*Fig* 14)

How long to continue artificial respiration will depend upon circumstances In general, it may be stated that if it is considered worth while attempting, it should never be abandoned until at least twenty minutes have elapsed Success has attended efforts sustained over much longer periods For instance, recovery has been recorded in a case of electric shock after four hours' artificial respiration

Long-continued Artificial Respiration—In respiratory failure from anterior poliomyelitis, artificial ventilation of the lungs may have to be continued for many months, and a mechanical device has to be employed to ensure this The best known of these mechanical respirators is the Drinker, in which the patient's body is placed in a cabinet, with his head projecting at one end The chest is dilated by reducing the pressure within the chamber, and expiration is effected by the actual elastic recoil of the lungs Forced respirations may be induced by raising the pressure, and so actively compressing the chest

TREATMENT OF COLLAPSE

POSTURE

The head should be lowered or the foot of the bed raised in collapse due to hæmorrhage, traumatic and surgical shock, anæsthesia, and electric shock It is often surprising how great an improvement can be effected by this means alone, or in combination with the adequate provision of warmth Simple postural treatment is also easy to apply as a first-aid measure Howat has pointed out that elevation of the limbs is a method of postural treatment splendidly applicable to first aid The first-aider stands astride the head of the supine patient, and raises the lower limbs to the vertical (*Fig* 15) By pulling on the legs, the pelvis can even be raised off the surface Such elevation of the limbs not only renders them bloodless, but induces a reflex vasoconstriction of the limb vessels The measure is so effective that the pelvis can be lowered in a few minutes, and in some cases the effect is enhanced if the arms are similarly elevated by a second worker

Fig 15 — Invoking the aid of gravity in the first aid treatment of the shock hæmorrhage syndrome.

APPLICATION OF HEAT

In all forms of collapse, and particularly so in external hæmorrhage, this is a most important supplementary measure It has been shown that heat accelerates the production of *a blood-coagulating substance in damaged tissues*, and favours the arrest of the bleeding

Warmth may be applied in the form of suitably protected hot water bottles, electric blankets, or "shock" cages fitted with electric bulbs

In severe cases of shock, the type of shock cradle used should be an all metal one, which reflects and retains the heat. *Cages of wire netting are less effective in emergency*

Infusion and Transfusion—Saline infusions (Chapter XI), blood transfusion, and particularly plasma transfusion (Chapter XII) are of the greatest value as resuscitative measures

The Administration of Oxygen (Chapter XXVII) also plays a great part

Oxygen-Carbon-dioxide Therapy—In most forms of collapse and respiratory failure or asphyxia, the respiratory centre is in need of stimulation For this purpose, CO_2 is added to the oxygen administered A useful mixture is 7 per cent CO_2 in 50 per cent oxygen The increased activity of the lung hastens the return of normal respiration, and in addition, by preventing or diminishing the blockage of alveoli, tends to prevent secondary pneumonia Oxygen-carbon dioxide administration is particularly useful in poisoning by carbon monoxide and the lung irritant gases, and in electric shock

RESTORATIVE DRUGS

No drug yet discovered has been universally acclaimed as the perfect analeptic Many have been, or are, in vogue, and some are useful in certain forms of collapse The house surgeon should be familiar with the indications for and the limitations of these

Strychnine, camphor, ether, and caffeine—the stand bys of a former decade—are practically without value, and find no place in the modern resuscitation wards They have been largely supplanted by coramine, cardiazol, and picrotoxin

Coramine and Cardiazol, despite their names, have virtually no action on the heart They are cerebral stimulants, and tend to restore consciousness and improve respiratory and circulatory function by their effect on the medulla Cardiazol has the more rapid action, and is probably the better Both are antidotal to higher levels of avertin and ether narcosis, but coramine is quite ineffective against the barbiturates, and in experimental chloroform poisoning it has been found almost to double the mortality

Cardiazol may be given by mouth or by injection, and in cases of great urgency, the intravenous route may be employed, 3 to 5 c c of a 10 per cent solution being administered to begin with In cases of drowning, further injection may be given, and recovery has been recorded after 45 c c had been used over a period of a few hours

Picrotoxin is similar to cardiazol in its action It is, however, almost specific for barbiturate poisoning (e g, pentothal) The usual dose is 0 5 to 2 mg, but from 3 to 10 mg may be given in divided doses It has been found that 1 mg is antidotal to 30 to 40 mg of pentothal, and this may be given intravenously, in 1-1000 solution

Ephedrine prevents the fall of blood pressure associated with spinal anæsthesia and in ½-gr doses intravenously generally restores the pressure to normal, if a fall has occurred already Its action is transient, and injections may have to be repeated as required, the intramuscular and subcutaneous routes are less dependable

Veritol is very satisfactory in raising the blood pressure (Dodd) Intramuscular injection of 0 75 to 1 c c begins to act in three to five minutes, intravenous injection acts within fifteen seconds and the usual dose is 0 25 c c It may usefully be combined with cardiazol, the twin injection is more effective than either alone

Adrenal Cortical Preparations have not yet become generally used Their cost is great, and they are difficult to get in a quantity sufficient for wide spread trial

Cortin, 5 to 10 c c intravenously, has been shown to be of value in cases of collapse from shock Desoxycortico-sterone acetate in 5 mg doses every two to four hours during the severe circulatory failure of burn shock has been shown by Wilson to correct certain blood changes and have an occasional beneficial circulatory effect, but it appears to be less active, and therefore less suitable in collapse, than cortin

IMPENDING DEATH UNDER ANÆSTHESIA

There must be few of those entering the portals of medicine who at some time or another will not come suddenly face to face with this, which ranks, after severe arterial hæmorrhage, as the most urgent of all emergencies

Patients who stop breathing and give rise to anxiety whilst under general anæsthesia may be divided into two main classes (1) Blue asphyxia (primarily respiratory), (2) White asphyxia (primarily cardiac)

Blue asphyxia seldom need give rise to serious concern The anæsthetist having cleared the airway, pulled the tongue forward, and administered oxygen, artificial respiration usually brings about a restitution In stubborn cases stretching the anal sphincter is a useful adjunct

White asphyxia calls for a calm, organized massed effort by the whole theatre staff In order to deal with the situation as efficiently as possible, it is necessary to have some preconceived plans upon which efforts to resuscitate the patient may be based

GENERAL MANAGEMENT (WITH SPECIAL REFERENCE TO BLUE ASPHYXIA)

In all cases it is assumed that the anæsthetist has cleared the airway, pulled the tongue forward, and is administering oxygen

Artificial Respiration —On receiving a request from the anæsthetist for artificial respiration, the most usual practice is for the operator to exert rhythmical pressure on the lower thorax Useful as this method is, I do not believe it should

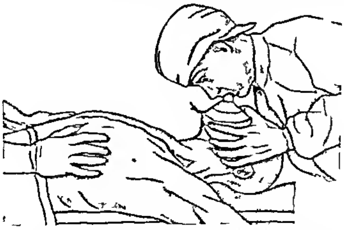

Fig 16 —Direct method of artificial respiration.

be carried on for more than a minute If after this period respiration has not recommenced, the field of operation, if near the thorax, should be covered with a sterile towel securely clipped by towel forceps to prevent its becoming deranged Silvester's artificial respiration is then carried out slowly, systematically, and symmetrically, usually by the surgeon's assistant, who summons an unoccupied helper

The Direct Method—The mouthpiece of a gas inhaler is generally at hand, and when placed in position on the patient's face makes an admirable funnel through which to blow and inflate the patient's lungs (*Fig* 16) In the absence of a face piece a funnel can be extemporized with the closed hand There is no resistance to overcome, the air easily enters and inflates the lungs, and is expelled automatically, or rather gurgles out with the help of gentle pressure on chest or abdomen The process is repeated every four or five seconds until normal rhythmical respirations are restored

WHITE ASPHYXIA

The Time Factor—It is probable that certain cases are prematurely abandoned as hopeless, owing to anxiety masking our estimation of time Minutes under these circumstances hang fire, if the clock is not watched

Is the Heart Beating?—If the operation in progress permits access to a large artery, it is the surgeon who should obtain this information When the integument is intact, it is the anæsthetist who must settle this point by the means he thinks best In our view the carotid pulse is the best indicator When the surgeon is unable to supply this information, so difficult and time-consuming is this all important question that in white asphyxia the correct procedure is to assume the worst, and to proceed with resuscitative measures according to a plan which provides for confirming the necessity of heroic measures by the best means available

Distribution and Duties of Personnel—With but three to three and a half minutes at our disposal, each must know his or her duty, providing they know exactly what to do, even semi-skilled and unskilled members of the theatre team can perform most useful parts

Time-keeper A student, a junior nurse, or a porter should be detailed to cry loudly each passing minute from the time the anæsthetist sounds the warning note of danger

Provider of hot packs If, in addition to a time keeper, there is a junior nurse available, her duty should be to get a bowl of really hot water and some packs, and be prepared to place the packs, wrung out in hot water, on the precordium at frequent intervals while the artificial respiration is in progress This worker is not essential She should go about her duties without asking questions or distracting the attention of the theatre sister Her services should be at the disposal of the surgeon's assistant if he should require them

The surgeon's assistant is dismissed immediately by the surgeon, and relegated to the sole task of performing artificial respiration under the direction of the anæsthetist He carries out Silvester's procedure—if necessary, single-handed—but summons the most suitable helper available

The theatre sister comes forward and takes on the duties of the surgeon's assistant Her essential objective is to have in readiness the simplest requirements for a midline upper laparotomy

The anæsthetist takes sole charge of the respiratory apparatus His first, and at all times his most important, duty is to be perfectly satisfied that there is a clear air-way His other essential parts can be played without moving his position from the patient's head They are (*a*) settling the question "Is the heart beating?" if required to do so, and (*b*) injecting adrenaline into the heart

A bottle of adrenaline should be at hand in the operating theatre This bottle is changed every two months, in order to make quite certain that the drug is in an active form The bottle of adrenaline, together with a sterile syringe and a 3½-in long needle

which fits that syringe, should be kept in a sealed sterile jar on the anæsthetist's table At the appropriate time (*see later*) the syringe is loaded with 1 c c of adrenaline and its needle is thrust into the fourth interspace at the upper rim of the fifth rib close to the sternal border The needle should be directed backwards and slightly medially

A (REVISED) PLAN OF ACTION

Artificial respiration must be started at once, and continued throughout the endeavour Intratracheal insufflation of oxygen and CO_2 is the ideal form of artificial respiration Silvester's method is efficient if the air-way is kept clear

First Minute —

Anæsthetist —Clears air way, tilts the table, even slightly, so as to lower the head, breaks a capsule of amyl nitrite under the patient's nostrils *

Surgeon —Appoints a time keeper, dismisses his assistant, with the help of the theatre sister attends to his operation so that it can be abandoned temporarily, if possible, palpates directly a large artery

Second Minute —

Anæsthetist —Administers oxygen, passes an intratracheal tube if circumstances permit and he is particularly skilled in this manœuvre

Surgeon —Supervises skin of upper abdomen and lower thorax being sterilized while he scrubs up or changes his gloves, as necessary

Theatre Sister —Prepares the skin of the upper abdomen and lower thorax

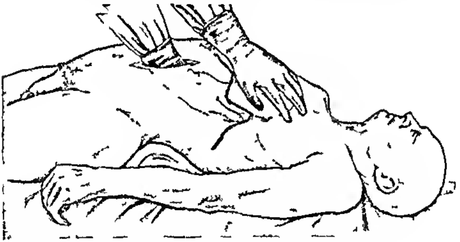

FIG 17 —Method of performing cardiac massage (*After Kirschner*)

Third Minute —

Anæsthetist —If asked to do so, palpates carotid artery, when free from duties of second minute, opens the cardiac emergency jar and places it within reach of the theatre sister

Surgeon —If the information received is that the heart is not beating, makes an incision in the middle line through the linea alba large enough to insert the hand, starts cardiac massage from below the diaphragm, at first with a quick, forcible movement for half a minute, the base of the left hand over the lower thorax aids in the manœuvre, if there is no response after thirty seconds, changes the movement to a slower rate of about eighty per minute (Fig 17)

* This valuable suggestion was made by W B Primrose, the object of administering this drug is to distinguish between cardiac depression and cardiac arrest.

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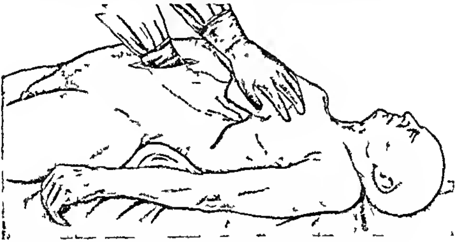

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* This valuable suggestion was made by W B Primrose, the object of administering this drug is to distinguish between cardiac depression and cardiac arrest

Theatre Sister —Fills the syringe with 1 c c of adrenaline and fixes the needle firmly to the barrel

Fourth Minute —

Surgeon —Removes his left hand from the thoracic wall while the adrenaline is injected into the heart by the anæsthetist, directly afterwards, with renewed hope, continues the massage as in the first instance, i e, quickly

Four-and-a-half Minutes —

Surgeon —Detaches diaphragm from left costal margin with a stroke of a scalpel, stretches opening to take hand, rhythmically squeezes the heart within the pericardium (this seldom fails to give at least a temporary response)

If the last manœuvre is successful, the opening in the diaphragm must be closed with catgut stitches It is quite sufficient to close the upper midline incision with strong, interrupted through and through sutures traversing all layers

COLLAPSE IN INTRAVENOUS ANÆSTHESIA

Providing the anæsthetic (pentothal or sodium evipan) is injected slowly and a good air way is maintained, complications and untoward reactions are uncommon. In collapse under intravenous anæsthesia 1 mg of picrotoxin is antidotal to 30 to 40 mg of pentothal It is given intravenously in 1–1000 solution When this drug is not available lumbar puncture has proved successful In a case occurring in the practice of Mr Max Pemberton, after oxygen and artificial respiration had proved unavailing, lumbar puncture resulted in the escape of cerebrospinal fluid under considerable pressure, and almost immediate improvement in the patient's condition

COLLAPSE IN SPINAL ANÆSTHESIA

There are two danger periods in spinal anæsthesia The first is almost directly after the injection, and the second is about twenty minutes later The main danger lies in a fall of blood pressure, which can be shown by the sphygmomanometer The ordinary measure to be taken is that of raising the blood-pressure by the injection of a pressor substance In practice, Labat's cardiac stimulant, ephedrine gr ½, or ventol 1 c.c. are recommended

'Heavy' solutions, i e, solutions of spinal anæsthetics containing glucose, are now rarely employed, and the following instructions are only applicable to the 'light', i e, isotonic, preparations, which include stovaine in saline, percaine, and neocaine

Soon after the intrathecal injection has been made, the operating table is tilted slightly by the head in order to counteract the fall of blood pressure If the pulse becomes poor, the table should be tilted still further, and this measure, combined with a cardiac stimulant, usually brings about some improvement If it does not do so quickly, intravenous saline should be ordered In the meantime the administration of oxygen and carbon dioxide is indicated, particularly if respirations are shallow and irregular

We have found that after a period of considerable alarm, the adoption of the above measures is usually effective With posture some improvement occurs, and by the time half a pint of saline has gravitated into a vein the period of anxiety has passed Before the patient is allowed to be transported to his bed, the table should be raised gradually to the horizontal position

ETHER CONVULSIONS

Carbon dioxide and oxygen should be administered at once, and the sooner an intravenous injection of sodium evipan or pentothal can be given, the better In practically every case after the injection of 3 to 5 c c of one of these drugs, the convulsions are controlled If necessary, the intravenous injection can be repeated Oxygen and CO_2 should be continued for some time after the convulsions have ceased, and an injection of lobeline to stimulate the respiratory centre appears to be useful

NOVOCAIN POISONING

It is extremely rare for a sudden catastrophe to occur as the result of a local anæsthetic indeed this is the great advantage of local anæsthesia However, one of us (H B) has seen four examples of poisoning by novocain, which is the least toxic of all the local anæsthetics It is possible, even when only a 1 per cent solution has been employed, if some of the fluid gets into a vein, for the following symptoms of novocain poisoning to occur The patient loses consciousness, and suddenly the whole body *becomes convulsed in a terrifying fit The jactitations are such that the limbs bang* against the table

The danger lies in the failure of the respiratory centre, which breaks down before that of the cardiovascular centre CO_2 and oxygen should therefore be administered without delay, and continued for a considerable time In one recent case sodium evipan was administered *The result was as dramatic as in cases of ether convulsion* The convulsion ceased forthwith With a view to diluting the circulating poison, the administration of continuous intravenous saline seems rational

CHAPTER III

BANDAGES AND BANDAGING

By Hamilton Bailey and Sister Pauline

Bandaging, it is said, is a lost art, with this we agree if it implies that some of the older complicated convolutions are no longer to be witnessed in the wards and operating theatres Nevertheless, modern methods of bandaging are efficient and less time-consuming

Fig 18—The sling

THE TRIANGULAR BANDAGE

The triangular bandage is the half of a square of 36 in, and is usually made of unbleached calico

Slinging the Forearm—The sling should be made just short enough to elevate the shoulder slightly, or the patient will not trust all the weight of the limb to it The hand should be held so that it is a little higher than the elbow (*Fig* 18)

THE ROLLER BANDAGE

The art of using the roller bandage requires practice The first thing to learn is how to distribute the pressure evenly The bandage must be kept rolled up—dropping it is a sure sign of a bungler—and held (as in *Fig* 19) three or four inches away while the finger and thumb are used to retain that part of the bandage which has been applied in its place

General Rules—Bandage from below upwards, and always have the upper part of the bandage looser than the lower Bandage smoothly without irregularities or creases Start from within outwards

The Reversed Spiral.—The manipulation known as 'reversing' is shown in *Fig* 19 The reversed spiral may be applied to the trunk or limbs It is liable to slip, is not elastic, and is not suited for the neighbourhood of joints

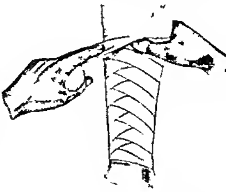


Fig 19—Application of the reversed spiral.

The Figure-of-8—Being not less firm, and yet more elastic, this bandage is useful in the neighbourhood of joints *Figs* 20, 21 will give a better idea of its application than words can express The great point to bear in mind is to make the loops of the '8' as

open as possible by going boldly up the limb and coming down again as far as the bandage will allow

The Spica (*Spike* or *spathe*, a botanical term applied to heads of seeds arranged as in an ear of wheat) —It is extremely useful for applying firm pressure to the shoulder, groin, thumb, or great toe

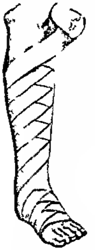


Fig 20 —Application of the figure-of 8

The Spica of the Groin —The patient lies with the pelvis supported on a pelvic rest The hip should be slightly flexed The bandage begins by two or three reversed turns from within outwards around the top of the thigh It is then carried outwards over the groin to just above the anterior iliac spine, and round the back just below the iliac crest It is then brought obliquely across the symphysis pubis, crossing over the starting-point Each successive turn overlaps two thirds of the one before it, and four or five such turns complete the bandage (*Fig* 22) It may be doubled and applied to both groins

Fig 21 —Figure-of 8 for the elbow

The Spica of the Shoulder —This is an extremely firm bandage The starting-point is taken from the upper arm, the turns being rolled round as high as the axillary folds will allow (*Fig* 23) The bandage is then brought through the axilla, over the shoulder, and round the chest, passing under the opposite armpit The crossing of the first turn should go as high upon the shoulder as the bandage

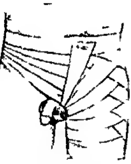


Fig 22 —Spica of the groin.

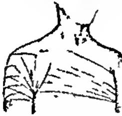


Fig 23 —Spica of the shoulder

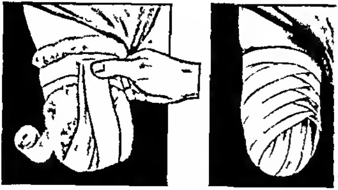
Fig 24 —Spica of the thumb

will lie This pattern requires a long bandage, and if required, it may be doubled for both shoulders as in the case of the groin spica

The Spica of the Thumb —The roller should be not more than ¾-in wide The spica is begun with a few turns around the wrist from above downwards (*Fig* 24)

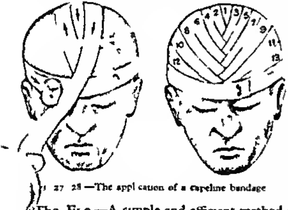
The Recurrent Bandage.—This is used for covering a stump The roller should not be more than 2 in wide for an amputation of the arm The

application of this bandage in the case of an amputation through shown in *Figs* 25 and 26



Figs 25 26 —The recurrent bandage for covering a stump

The Capeline —Two bandages are joined together by tackı behind the patient, holding one bandage in each hand, the join is centre of the fo two rollers are round the head ar the occiput One tinued round the other is carried to the calvarium, ea locked in the mar *Figs* 27 and 28 is completed In cases a flexible ad dressing (*see Fig* as efficient as th bandage here des



27 28 —The application of a capeline bandage

The Eye —A simple and efficient method of bandaging one eye is illustrated in *Fig* 29

The Moorfields Bandage covers both eyes It is made of firm material, such as calico or domette, with tape loops at both ends These loops pass behind the patient's ears, and are secured by a single tape attached to each loop, and tied in front (*Fig* 30)

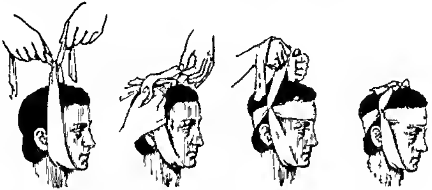
The Mastoid Bandage —Standing in front of the patient, the roller is passed completely round the head

he second turn is brought obliquely across the mastoid back to the starting lace, and so continued On completion, the free end of the roller is secured ith a safety pin (*Fig* 31)

Fig 31 —The mastoid bandage

The Jaw —*The Barrel Bandage* is now usurping e classical *four tailed bandage*, and *is proving* ore efficient Six feet of 2-in or 2½-in unbleached alico is required The middle of the bandage is laced under the jaw, well back just in front of the ngle, and the two ends are brought to the top of e patient's head and tied in a simple knot (*Fig* 2, A) Using two hands, the loops of the knot are pened (*Fig* 32, B) so that one loop is brought own in front of the forehead and the back loop nder the occiput The two ends of the bandage re now brought upwards, exerting tension at the ame time (*Fig* 32, C) The two hitches (one on ither side) are brought into position, slightly above nd in front of the ears The ends of the bandage *re secured by a reef knot over the vertex* (*Fig* 32, D)

An excellent method of immobilizing the lower jaw is shown in *Fig* 33 The only materials necessary are a surgeon's cap, a suitable piece of corugated rubber—now so commonly used in the operating theatre—and four afety-pins

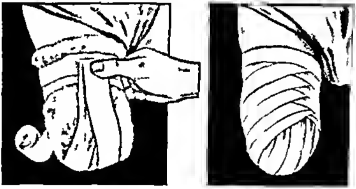


A B C D

Fig 32 —Application of the barrel bandage (*After Sir Harold Gillies*)

The Neck (with special reference to thyroid operations) —In order to apply efficient bandage after thyroidectomy three assistants are necessary, one to port the head and one for each arm It is now easy to ensure firm bandaging hout disturbing the patient unduly The first two turns encircle the chest above the level of the nipples The roller is then carried from the axilla, oss the front of the chest, and round the back of the neck, crossing the chest reach the other axilla This manœuvre is continued until the whole of the ple dressings are covered It is especially necessary to see that the dressing eath the chin is supported by the bandage—a turn or two around the head often necessary (*Fig* 34)

application of this bandage in the case of an amputation through the thigh shown in *Figs* 25 and 26



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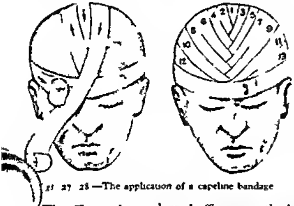

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Fig 29—Simple eye bandage

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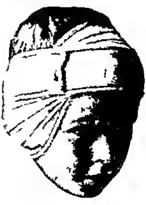


Fig 31 —The mastoid bandage

An excellent method of immobilizing the lower jaw is shown in *Fig* 33 The only materials necessary are a surgeon's cap, a suitable piece of corrugated rubber—now so commonly used in the operating theatre—and four safety-pins

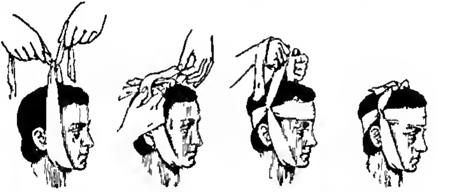


Fig 32 —Application of the barrel bandage (*After Sir Harold Gillies*)

The Neck (with special reference to thyroid operations) —In order to apply efficient bandage after thyroidectomy three assistants are necessary, one to pport the head and one for each arm It is now easy to ensure firm bandaging thout disturbing the patient unduly The first two turns encircle the chest st above the level of the nipples The roller is then carried from the axilla, ross the front of the chest, and round the back of the neck, crossing the chest reach the other axilla This manœuvre is continued until the whole of the nple dressings are covered It is especially necessary to see that the dressing neath the chin is supported by the bandage—a turn or two around the head often necessary (*Fig* 34)

If the patient is inclined to vomit, the whole of the dressing is covered with a layer of jaconet fitted to the neck and stitched into position

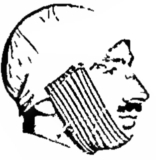


Fig 33 —An alternative method of immobilizing the lower jaw

Fig 34 —Bandage applied to the neck after thyroidectomy

THE MANY-TAILED BANDAGE

When a dressing requires changing frequently, the many-tailed bandage is particularly valuable It can be used for the abdomen, thorax, breast, or for a limb

For the Abdomen—The abdominal many-tailed bandage is used in the majority of clinics It is a method of bandaging the abdomen which has stood the test of time, and on the whole it is satisfactory If the perineal stirrups are omitted the bandage tends to ride upwards, it is the omission of these essential stirrups, rather than the bandage itself, which has led to undeserved adverse criticism

The bandage (*Fig* 35) is made as follows To a square of flannelette measuring 12 × 12 in., five strips 5 in. wide and from 36 to 48 in. long are stitched at right angles in such a way that they overlap one another for two-thirds of their width

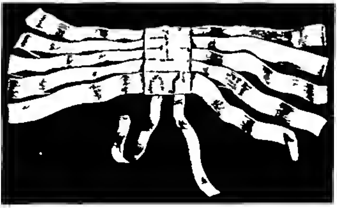


Fig 35 —A many-tailed bandage.

In order to apply the bandage properly, two persons are necessary A rolls the patient towards himself, while B insinuates the bandage under the back just beyond the middle line B now rolls the patient towards himself, while A retrieves the bandage Commencing from below upwards A and B alternate

in bringing the strips of the many tail across the abdomen with firm pressure, the final strip is secured with a safety-pin

The lower part of the bandage may be applied firmly with advantage, but the upper part must not be tight

Special Precaution—The groins should be well padded with soft cotton wool, or the stirrups will cause friction

For the Breast—After amputation of the breast a many tailed bandage can be applied, not forgetting stirrups for the shoulders A spica to the shoulder is a valuable addition, for it provides adequate support and pressure where *it is most needed (Fig 36)*

Fig 36—Bandage after amputation of the breast A many tailed bandage has been supplemented by a spica to the shoulder

In those cases of abscess of the breast which are being treated by the closed method (*see* Chapter LI), the many tailed bandage is absolutely necessary

For the Thorax—After an empyema has been drained, a many tailed bandage with shoulder stirrups is unsurpassed The tube can be brought out between the tails of the bandage

THE T BANDAGE

The T-bandage consists of a double fold of firm material such as calico or flannelette, 48 × 4 in, for the waist piece, in the middle of which a single piece of material, about 36 × 7 in, is firmly sewn (*Fig* 37) The waist piece is passed round the patient, with the sewn portion at the centre of the back The wider strip is brought from the back, upwards, between the patient's thighs, and secured to the waist-piece in front This bandage can be used for either female or male cases by making the wide strip into one or two tails

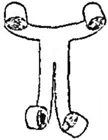


Fig 37—The T bandage for the male

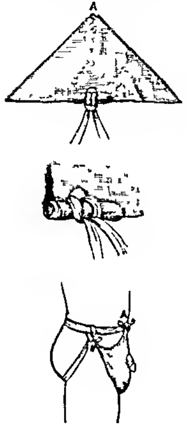
Fig 38—Method of securing a T bandage The loose ends are knotted. (*After Gabriel*)

The T bandage is very efficient It is important to maintain firm pressure on the dressing with the hand until the T-bandage has been tied securely (*Fig* 38)

NITSCHKE'S SCROTAL BANDAGE

We have found this a most excellent scrotal support, and apply it as a routine after operations upon the testicle or the inguinal canal It is particularly valuable after operations for hernia, and by its regular use the complication of

post-operative scrotal hæmatoma can be prevented It should be noted carefully that the bandage is made of butter muslin, which in Canada is known as 'cheese cloth'



A square of butter muslin, measuring 18 × 18 in, is folded diagonally (*Fig* 39) A small roll of gauze about 3 in long and ½-in thick is placed in the centre, between the layers of the preceding fold Just above the roll a small hole is made with a pair of blunt-ended scissors A piece of 2½-in bandage, 16 in long, is folded in the middle, the folded end is pushed through the opening made in the gauze and looped through Another piece of bandage is tied round the patient's waist and the scrotal bandage is applied firmly, so as to elevate the scrotum The ends are fixed as shown in the last two figures Then two ends of the gauze are tied to the waistband, after which a hole is made in the gauze to accommodate the penis

Fig 39—An easily constructed scrotal support

CHAPTER IV

BANDAGES AND BANDAGING: ADHESIVE PLASTER TECHNIQUE

By Hamilton Bailey and Sister Pauline

The use of adhesive plaster for bandaging is becoming popular Under the term 'adhesive plaster' we include *flexible* adhesive plaster, which is issued under a variety of somewhat perplexing proprietary names such as Elastoplast, Flexoplast, Leukoplast, and Pressoplast Unless otherwise stated, it is *flexible* adhesive plaster which is to be employed in the bandages about to be described

Bandaging with adhesive plaster has certain advantages Adhesive plaster *does not become loose, nor can it become displaced, also it prevents the patient* from surreptitiously inspecting his wound Its main disadvantages are that in some patients it tends to cause skin irritation and its removal is not painless These disadvantages can be minimized considerably by correct technique —

Fig 40.—Removing flexible adhesive plaster little by little after applying a solvent on a swab as shown. *This renders the process almost painless*

1 Adhesive plaster should never be applied unless the skin is hairless, or has been shaved adequately

2 It should not be applied to skin which has been recently painted with iodine—at the conclusion of the operation the wound alone is painted, not a wide surrounding area

3 The plaster should be peeled off towards the centre, working from two opposite ends simultaneously

4 *If the adhesive plaster is moistened with one of the preparations called* Zoff (T J Smith and Nephew) or Antiphesin (Allen and Hanbury), the dressing peels off much more easily

A gauze swab is saturated with one of these preparations and applied to the under surface of the plaster Using the moistened swab as shown in *Fig* 40, the adherent plaster can be removed painlessly

We will describe some typical examples of the use of adhesive plaster for bandaging, indicating where necessary its advantages or disadvantages as opposed to the corresponding methods in the preceding chapter Actually, we are using adhesive plaster relatively more frequently than hitherto, and the reports from the patients and the ward sisters appear to justify the preference

Fig 41—Adhesive plaster dressing for the head

THE HEAD

Instead of a bulky and conspicuous capeline bandage, a useful dressing for scalp wounds is shown in *Fig* 41 A strip of flexible adhesive plaster, 2½ in wide, is employed The plaster is prepared by placing one layer of plain gauze to all that part of the sticky surface which will come in contact with the hair The ends are slit for a length of 3 in, and the bifurcations are stuck to the skin on either side of the ears

THE NECK

After operations upon the neck a single turn of adhesive plaster applied as shown in *Fig* 42 provides a quick and efficient method of keeping the dressings in position

Fig 42—A single turn of flexible adhesive plaster was sufficient to keep the dressing in place in this case of block dissection of the glands of the neck for malignant disease

The Thyroid—Immediately after subtotal thyroidectomy for toxic goitre, we still prefer the firm support afforded by the roller bandage, but in the later stages of convalescence of these cases, and as a primary bandage after enucleation of thyroid adenomata, the 'stole' bandage is excellent When the time comes for removal of the drainage tube or the stitches, the flexible plaster bandage can be cut, either in front, as shown in *Fig* 43, or at the back. The 'stole' can then be reconstituted once again by approximating the cut edges with safety pins or lacing

Fig 43—The stole If it is cut along the line A B the dressing may be changed and the severed portions re-joined with safety-pins.

THE BREAST

After operations for removal of simple tumours of the breast a flexible adhesive plaster dressing is ideal A hole should be cut for the nipple (*Fig* 44) In this case the patient had a fibro-adenoma removed under local anæsthesia as an out-patient, and the bandage ensures that the wound will not be interfered with until she attends for the removal of the stitches

Fig 44 —A fibro-adenoma has been removed under local anæsthesia A hole has been cut to accommodate the nipple

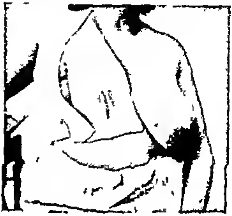


Fig. 45 —A method of strapping the breast.

Strapping the Breast.—An extremely efficient method is illustrated in *Fig* 45 The strips of plaster are made to adhere inferiorly and then carried over the shoulder In this way the breast is elevated and supported

THE THORAX

Strapping the Ribs.—Ordinary flexible plaster must be avoided in this instance The old-fashioned rigid adhesive plaster is excellent for the purpose, or there is a variety of Elastoplast which is elastic only in its width, and not in its length The strips should be 4 in wide The patient sits, if possible, with his arm raised and his hand resting upon his head or supported by an assistant The first strip is applied inferiorly It is made to adhere over the spine at the level of the 12th rib The patient is then told to expire to the fullest degree, and the strip is carried round and made to adhere evenly as far as the sternum With the curves of the ribs serving as a guide, further strips are applied

Fig 46 —Strapping the ribs.

during expiration in such a way that each strip overlaps the preceding strip by a third of its width (*Fig* 46)

After Empyema Operations—When the 'closed' operation with rib resection has been performed for empyema, flexible adhesive plaster applied over the wound and the outer flanges of the Tudor Edwards tube helps considerably in making the drainage truly 'closed', i e , water tight

THE ABDOMEN

We find that adhesive plaster dressings are particularly satisfactory after many abdominal operations Take for instance, gridiron appendicectomy A gauze dressing is applied, and this is covered with a square of flexible adhesive

Fig 47—Gridiron appendicectomy Over the gauze dressing a square of flexible plaster has been applied.

Fig 48.—Mayo's elliptical incision dressed with overlapping strips of flexible adhesive plaster

plaster in the manner shown in *Fig* 47 Another typical example can be seen in *Fig* 48 The patient has had Mayo's operation performed for an umbilical hernia Strips of adhesive plaster are applied which cover the wound completely and provide excellent support

Fig 49—Operation for inguinal hernia Repair by Gallie's graft The inguinal region has been bandaged by strips of adhesive plaster The sutured wound of the thigh has been covered by a single strip of the same material.

After hernia operations well applied flexible plaster is second to none In *Fig* 49 is shown a patient who has had a large inguinal hernia repaired by Gallie's fascial graft. The site of the operation has been covered by strips of flexible adhesive plaster, and a long strip covers the sutured wound of the thigh It should also be noted that Nitschke's scrotal bandage (*see* p 19) has been applied in this case

After herniotomy in an infant flexible adhesive plaster is applied as shown in *Fig* 50 To cover the area with oiled silk, kept in place by more flexible adhesive plaster as shown in *Fig* 51, is an excellent practice The penis is brought out through a suitable hole If, in addition, a splint which reaches from the axilla to the ankle is strapped to the lateral side of the patient by further adhesive plaster, the

operative area is immobilized so well that many of these patients can be sent home as soon as they have recovered from the anæsthetic

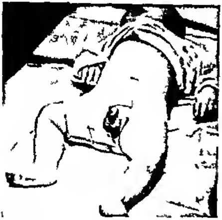


Fig 50—Herniotomy has just been performed A single layer of gauze is covered by flexible adhesive plaster

Fig 51—Note the oiled silk protective covering and the splint which will be applied from the axilla to the ankle

The 'Watershed' Dressing.—The 'watershed' dressing is used to separate two wounds, notably a laparotomy incision from a colostomy or a cæcostomy

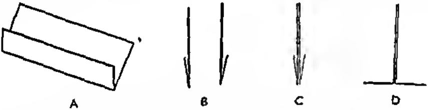


Fig 52—Making a watershed *A Method in which the strips of adhesive plaster are folded B Approximation of the strips held by the surgeon and assistant, C, The strips approximated, D The watershed applied to the abdomen*

It ensures the former is not contaminated by the discharge from the latter *Non-flexible* adhesive plaster is used

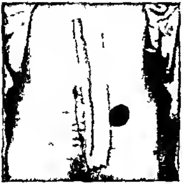


Fig 53—'Watershed' in action

A strip of broad adhesive plaster about 6 in long is taken by the surgeon, and a similar piece of exactly the same length by the working assistant Facing one another, and independently but simultaneously, both the surgeon and the assistant fold their piece of plaster *longitudinally* (*Fig* 52, A) The surgeon now approaches the assistant, and the strips of plaster are placed back to back (B and C) The surgeon then takes the two pieces, the backs of which have adhered to one another and applies the 'watershed' to the abdominal wall between the two wounds (D) *Fig* 53 shows the 'watershed' in action

In addition to preventing fæcal contamination of the laparotomy wound, it serves to remind the nurse that the two dressings must be performed separately

Laparotomy Corsets.—We find the ready made abdominal laparotomy corsets manufactured by Biersdorf & Co, of Welwyn, exceedingly valuable, particularly if the wound is threatening to break down or the patient has a persistent cough. The timely use of these corsets will prevent many 'burst abdomens'

In certain cases—for instance, in a very stout patient or when the wound is transverse—it will be found that the corsets fit much better and are more comfortable if they are cut every three or four inches Cutting the corsets makes them more pliable and enables them to be fitted to an uneven contour In order to avoid explanation of the method of cutting, a reference to *Fig* 54, A, B, C, will make the procedure quite clear (*see also* Corsettage of Wounds in General, p 28)

A

B

C

Fig 54.—A If the corset is cut as shown it can be adapted to the contour of the abdomen B This shows the appearance of the corset after cutting. The adhesive surface is applied evenly to the lateral abdominal wall and held until it has adhered firmly C, The corset in use

THE SCROTUM

As a post-operative bandage the Nitschke scrotal bandage (*see* p 19) is unsurpassed, but the Bellevue bandage has its uses, and it is valuable in cases of mild epididymo-orchitis where the patient has to be treated ambulatorily

The Bellevue Bandage.—Instructions for making the bandage are epitomized in *Fig* 55 Either ordinary adhesive plaster or flexible plaster can be used The top of the bandage is divided into two equal parts by tearing it down for

12 in An inverted V is cut in the other end of the plaster 16 in deep, to make two perineal strips A piece of gauze 4 in wide and a roller bandage 2½ by 1 in are placed as shown, the latter is best stitched to the adhesive

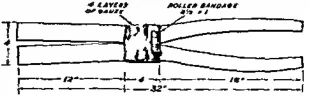


Fig 55—The Bellevue bandage

The bandage is applied in the following manner The scrotum is elevated and the gauze pad is applied to the perineum, the roller bandage being tucked behind the root of the scrotum The other hand places the broad strips over the inguinal regions, and they are held until they stick firmly (*Fig* 56) The perineal strips are then brought round the thighs in the gluteal folds, over the anterior superior spines To make the suspensory bandage stick to the skin

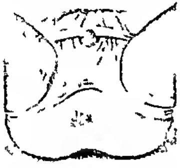


Fig 56—The Bellevue bandage applied

Fig. 57—A scrotal sling

better, another piece of adhesive plaster is made to adhere over the hypogastrium from one great trochanter to the other

A Scrotal Sling is made by applying broad adhesive (non-flexible) plaster to the thighs in the manner shown in *Fig* 57 With the legs in apposition and the scrotum elevated, the strip of adhesive plaster is applied tightly across the thighs, well up towards the perineum A little pad of cotton-wool, upon which is sprinkled dusting powder, makes a good nest upon which the testicles can lie A bed-cage is used to prevent pressure from the bedclothes

The main use of the scrotal sling is in cases of acute epididymo-orchitis

Fig 58—Applying a flexible adhesive plaster bandage to a sprained ankle

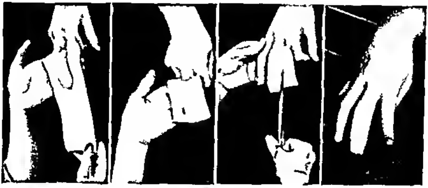
JOINTS

For many joint conditions, particularly sprains, the adhesive plaster bandage is indispensable As a typical example will be taken the case of a torn external lateral ligament of the ankle-joint A strip of adhesive plaster is applied to the

dorsum of the foot and continued to half-way up the leg An adhesive plaster bandage is then applied in wide figure-of-8 turns, care being taken to keep the foot flexed and everted (*Fig* 58)

THE FINGER

A strip twice the length of the finger is cut from a 2½-in roll of flexible plaster It is applied on the flexor surface as shown in *Fig* 59 Using one half for the front, the other half is turned over the top to cover the back The two



A B C D

Fig 59—A A strip of flexible adhesive plaster is applied to the finger as shown, B The excess at each side is pressed together C, The excess is cut away, D The dressing completed.

sides of the bandage will adhere to each other They are pressed together carefully, the excess being cut away with scissors Care must be taken not to apply this dressing tightly, and to be sure that a small part of the adhesive plaster below the dressing is in contact with the skin

CORSETTAGE OF WOUNDS IN GENERAL

Reference has been made previously to ready made abdominal corsets (p 26), but a wound in any situation may require corsettage (*Fig* 60) Again, ready-made abdominal corsets may not be available for use in an abdominal wound, when one of the methods about to be described is an efficient substitute By the early and intelligent use of corsettage in appropriate cases the final closing of a wound is often expedited by many weeks and the number of wounds requiring secondary suture is reduced considerably

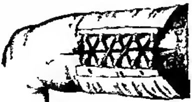


Fig 60—Corsettage of a wound of the thigh.

Sir Robert Kelly's Method—A piece of strapping is folded longitudinally, not quite in the midline, its sticky side outwards Nicks are made with scissors (*Fig* 61, A) in the fold, just large enough to allow a dressmaker's hook, but not its flattened arch, to be pulled through When enough hooks have been inserted a second piece of strapping is placed over the first, sticky side down (*Fig* 61, B)

The strapping is fixed to the skin parallel with and about one and a half inches from the edges of the wound The hooks are then laced with a length of stout silk

A B

Fig 61 —Kelly's method of fixing dressmaker's hooks to adhesive strapping

Learmonth's Method —Two strips of adhesive plaster are folded round glass rods in such a way that the adhesive surface does not come in contact with the dressing When the adhesive plaster has adhered to the skin, strong rubber bands are applied as shown in *Fig* 62

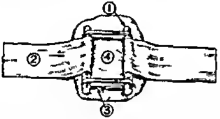


Fig 62 —Method of fixing a dressing which requires frequent changing (1) Glass rods, (2) Strips of flexible plaster folded round the glass rods so that the adhesive surface does not come into contact with the dressing (3) Rubber bands (4) Dressing (*After Learmonth*)

CHAPTER I

IN THE PATHOLOGICAL I

By H G Close

The house surgeon is the liaison officer between the departments He will find this work interesting a in this direction quickly bears fruit to the mutual

I COLLECTION OF SPECIMENS FOR TO THE PATHOLOGICAL DEPA

1 **Tissues for Histological Examination.**—The containers and covered with 4 per cent formalin in tap latter, called 'formol saline', should be used if possil shrinkage of the tissue in the process of fixing Tissues p dilution of formalin can be used for frozen sectioning as well

It is highly important that these (and all other specimen clearly with the name, da e, and nature of the investigati stick-on labels are available, a piece of fairly stiff paper is to written on it in pencil, and it is then *placed in the conta* solution will not erase the pencil

If more than one portion is to be sent, each specimen shoul separate container and labelled appropriately For example —

1 Ellen Philpot Oct 3 37 Portion of growth from bre
2 Ellen Philpot, Oct. 3 37 Lymphatic gland from axilla

2 **Specimens for Permanent Mounting**—The specimen i formol saline if possible, or, if that is not available, in 5 to 10 per c in tap water The colour v change after a while, but will ret the specimen is placed in k solution In the case of soft tiss brain, the specimen should be all rest on a layer of cotton wool i fixing fluid

Fig 63 —Screw-capped bottle for pathological specimens (*United Glass Bottle Co*)

Fig 64.—A swab stick.

3 **Fluid Specimens**—Pus is p a sterile test tube or sterile screw cap bottle (*Fig* 63) Pleural fluid, asc fluid, or cerebrospinal fluid is dealt with the same way, though it is a definit advantage sometimes to use two tubes One tube has a crystal or two of potassium oxalate (to prevent the formation of a clot), the other is a plain tube

4. **Throat Swabs, etc.**—Swab sticks (*Fig* 64) are sterilized before they are sent to the wards or theatres The swab stick is withdrawn, rubbed on the ulcer or in the drop of pus (if there is a minute amount of pus), and replaced in

the container The swab should be sent to the laboratory before the material to be examined can dry up If the material cannot be dealt with for some hours, it is advisable to smear the swab stick over the surface of some routine culture medium such as nutrient agar If diphtheria is suspected, the throat swab is smeared on inspissated serum medium (an opaque white or creamy medium)

5. **Blood.**—

Serum—From 5 to 10 c c of blood are withdrawn by means of a dry sterile syringe The blood is immediately transferred to a dry sterile test-tube or sterile screw-capped bottle It is allowed to clot The amount of serum obtained is approximately half the volume of blood withdrawn

The following examinations are carried out on serum —

Wassermann reaction
Kahn and similar precipitation tests for syphilis
Gonococcal complement-fixation test
Van den Bergh reaction and icterus index
Calcium content
Uric acid content
Phosphatase content
Compatibility test with donor's red blood-cells
Widal reaction and other reactions of a similar kind (which depend on an increase of antibodies to a particular organism)

Whole Blood (i e, non-coagulated blood)—About 5 c c of blood are withdrawn as in the case of serum, but the blood is placed in a tube containing several crystals of potassium oxalate and is shaken well to prevent clotting If too much oxalate is used, the blood will become thick and dark and will be useless for investigations

The following estimations can be done on whole blood —

Blood-urea
Blood-sugar
Blood grouping (indirect method)
Hæmoglobin percentage
Red cell count
White-cell count
Blood-phosphate
Fragility of the red cells

Blood-sugar—If the estimation cannot be done within about three to four hours of withdrawal of the blood, it is advisable to use a small amount of sodium fluoride in place of potassium oxalate in the container Fluoride prevents glycolysis

Blood smears for the detection of malarial and other parasites are made as described on page 35 Blood-smears for malaria, etc, should be made when the patient's temperature is rising

Blood-culture—The skin in the antecubital fossa is cleaned thoroughly with spirit and ether, and a dry sterile syringe is used to withdraw about 10 to 15 c c of blood One should use four to six culture tubes containing a liquid medium e g, broth, and it is a good plan to vary the amount of blood added to each tube For example, put 1 c c into one tube, 2 c c into the second, 3 c c into the third, and so on It is also advisable to have one or two tubes of glucose broth as well as the plain broth ones The culture tubes should be put in the incubator (37° C) immediately after the blood has been withdrawn At the end of forty-eight hours (sometimes earlier) the tubes are examined for evidence of growth of organisms

CHAPTER V

IN THE PATHOLOGICAL DEPARTMENT

By H G Close

The house surgeon is the liaison officer between the pathological and the surgical departments He will find this work interesting and stimulating, his keenness in this direction quickly bears fruit to the mutual advantage of all concerned

I COLLECTION OF SPECIMENS FOR TRANSFER TO THE PATHOLOGICAL DEPARTMENT

1 **Tissues for Histological Examination** —These are put into suitable containers and covered with 4 per cent formalin in tap water or saline The latter, called 'formol saline', should be used if possible, as it leads to less shrinkage of the tissue in the process of fixing Tissues preserved in the above dilution of formalin can be used for frozen sectioning as well as routine sectioning

It is highly important that these (and all other specimens) should be labelled clearly with the name, date, and nature of the investigation required If no stick-on labels are available, a piece of fairly stiff paper is taken and the details written on it in pencil, and it is then *placed in the container* The formalin solution will not erase the pencil

If more than one portion is to be sent, each specimen should be placed in a separate container and labelled appropriately For example —

1 Ellen Philpot, Oct 3, 37 Portion of growth from breast
2 Ellen Philpot, Oct 3, 37 Lymphatic gland from axilla

2 **Specimens for Permanent Mounting** —The specimen is placed in formol saline if possible, or, if that is not available in 5 to 10 per cent formalin in tap water The colour will tend to change after a while, but will return when the specimen is placed in Kaiserling solution In the case of soft tissues, e g, brain, the specimen should be allowed to rest on a layer of cotton wool in the fixing fluid

Fig 63 —Screw-capped bottle for pathological specimens (*United Glass Bottle Co*)

Fig 64 —A swab stick

3 **Fluid Specimens** —Pus is put in a sterile test tube or sterile screw-capped bottle (*Fig* 63) Pleural fluid, ascitic fluid, or cerebrospinal fluid is dealt with in the same way, though it is a definite advantage sometimes to use two tubes One tube has a crystal or two of potassium oxalate (to prevent the formation of a clot), the other is a plain tube

4 **Throat Swabs, etc** —Swab sticks (*Fig* 64) are sterilized before they are sent to the wards or theatres The swab stick is withdrawn, rubbed on the ulcer or in the drop of pus (if there is a minute amount of pus), and replaced in

the container. The swab should be sent to the laboratory before the material to be examined can dry up If the material cannot be dealt with for some hours, it is advisable to smear the swab stick over the surface of some routine culture medium such as nutrient agar If diphtheria is suspected, the throat swab is smeared on inspissated serum medium (an opaque white or creamy medium)

5. **Blood.**—

Serum—From 5 to 10 c c of blood are withdrawn by means of a dry sterile syringe The blood is immediately transferred to a dry sterile test-tube or sterile screw-capped bottle It is allowed to clot The amount of serum obtained is approximately half the volume of blood withdrawn

The following examinations are carried out on serum —

Wassermann reaction
Kahn and similar precipitation tests for syphilis
Gonococcal complement-fixation test
Van den Bergh reaction and icterus index
Calcium content
Uric acid content
Phosphatase content
Compatibility test with donor's red blood-cells
Widal reaction and other reactions of a similar kind (which depend on an increase of antibodies to a particular organism)

Whole Blood (i e, non-coagulated blood)—About 5 c c of blood are withdrawn as in the case of serum, but the blood is placed in a tube containing several crystals of potassium oxalate and is shaken well to prevent clotting If too much oxalate is used, the blood will become thick and dark and will be useless for investigations

The following estimations can be done on whole blood —

Blood-urea
Blood-sugar
Blood grouping (indirect method)
Hæmoglobin percentage
Red-cell count
White-cell count
Blood-phosphate
Fragility of the red cells

Blood sugar—If the estimation cannot be done within about three to four hours of withdrawal of the blood, it is advisable to use a small amount of sodium fluoride in place of potassium oxalate in the container Fluoride prevents glycolysis

Blood-smears for the detection of malarial and other parasites are made as described on page 35 Blood-smears for malaria, etc, should be made when the patient's temperature is rising

Blood-culture—The skin in the antecubital fossa is cleaned thoroughly with spirit and ether, and a dry sterile syringe is used to withdraw about 10 to 15 c c of blood One should use four to six culture tubes containing a liquid medium e g, broth, and it is a good plan to vary the amount of blood added to each tube For example, put 1 c c into one tube, 2 c c into the second, 3 c c into the third, and so on It is also advisable to have one or two tubes of glucose broth as well as the plain broth ones The culture tubes should be put in the incubator (37° C) immediately after the blood has been withdrawn At the end of forty-eight hours (sometimes earlier) the tubes are examined for evidence of growth of organisms

Blood Grouping.—Two tubes should be sent to the laboratory: one containing a few c.c. of oxalated or citrated blood; the other about 5 c.c. of plain blood (for serum). The red cells of the non-coagulated blood are used to determine the patient's group; the serum, for the direct compatibility test, i.e., mixing the patient's serum with the prospective donor's red cells.

Some Points to Bear in Mind in the Collection of Blood.—It is useful to remember that blood-sugar and blood-urea estimations are usually made on small amounts of blood, viz., 0.2 c.c. This small amount, however, is not easy to collect from a finger-prick or from the ear without practice. Small details, such as a sharp three-sided needle, a warm skin, and the use of pure ether (and not 'ether meth.') to clean the skin may make all the difference between success and failure.

The collection of blood from infants, where venipuncture is not practicable, may also be difficult at times. Under these circumstances, it is often wiser to call in an expert, who will probably be able to extract a few cubic centimetres from the finger or heel.

Fig. 65.—The Behring venule.

A convenient tube for the collection of blood is sold by Bayer Products Ltd., and is called a Behring venule (*Fig.* 65). Plain tubes and tubes containing oxalate, fluoride, broth, etc., are sold. The needle is encased in a glass sheath. A 'vacuum' in the tube draws up the blood from the vein. These tubes are particularly convenient when specimens of blood have to be sent through the post.

II. TECHNIQUE OF CERTAIN EXAMINATIONS

In the absence of the pathologist, the house surgeon may be called upon to undertake certain examinations himself. The following are among the most important.

EXAMINATION OF BLOOD

Nomenclature.—Formerly blood groups were categorized according to Moss's classification as I, II, III, IV. The newer international classification is AB, A, B, and O. I = AB; II = A; III = B; IV = O.

Grouping of Blood, as a Preliminary to Blood Transfusion.—

The Indirect Method.—It is necessary to have tubes of stock serum of Groups A and B. The serum must not be more than three months old. Stock sera can be procured from the Lister Institute and from leading firms who put up sera and vaccines.

Fig. 66.—A 'welled' slide.

A white tile or a 'welled' slide (*Fig.* 66) (an ordinary glass slide with three shallow depressions or wells) is taken and on this is written A and B. Under A is placed one drop of stock serum A. Under B is placed one drop of stock serum B. The recipient's ear is sterilized with ether and pricked with a sterile needle. A drop of blood is squeezed out, and with a glass rod or the bacteriologist's 'platinum' loop, a little of it is

transferred and mixed intimately with the drop of stock serum A The amount of blood should be quite small, sufficient to impart a definite red tint, but not enough to colour the serum deeply Most of the mistakes in reading the results are due to using too much blood The golden rule is "much serum, few cells" (i e, a very small quantity of blood) The glass rod

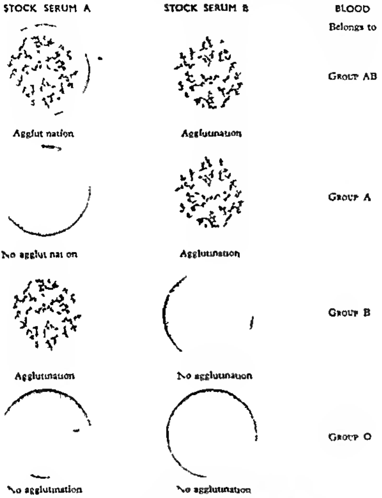


Fig 67 —Chart showing method of identifying the different blood groups (*Wood and Ross*)

is washed and dried—if the platinum loop is used, it may be dried in a flame or on blotting paper—and a little more blood from the lobule of the ear is transferred and mixed with the drop of stock serum B The tile (or slide) is then gently rocked so as to impart a little movement to the drops They are examined in a good light Agglutination can be seen against a white background with the naked eye If agglutination occurs within a minute or two of mixing, the redness within the drop becomes patchy and may be likened to brick-dust If there is no agglutination at the end of about fifteen minutes, it can be assumed

that the test is negative The reaction in the two drops is noted, and the result compared with the chart (*Fig* 67), by the aid of which the group to which the recipient belongs can be found Exactly the same procedure is adopted in ascertaining the group to which the donor belongs

If possible a donor of the same group as the recipient should be procured If it is decided to utilize a Group O donor, or if there is time to do a confirmatory test whatever group donor is used, the test that follows should be applied

The Direct Method—This method is very useful for the isolated worker who has not immediate access to the stock sera

A hypodermic syringeful of blood is collected from a vein of the potential recipient and the blood is evacuated into a test tube, and allowed to clot When firm clotting has taken place, a little of the residual clear serum is removed with a pipette One drop of this is placed upon a white tile The prospective donor s ear is sterilized and pricked, and with a glass rod a small portion of blood is transferred to the centre of the drop on the slide After mixing and rocking gently for at least five minutes, the drop is examined in a good light with the naked eye If no agglutination occurs after ten to fifteen minutes, the prospective donor s blood is compatible with that of the patient The same rule applies in the direct method as in the indirect—much serum in proportion to the small amount of blood used

Leucocyte Count—A leucocyte count is often required urgently A series of leucocyte counts on alternate days is also a useful measure when it is suspected that an abscess is forming

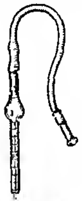


Fig 68—Pipette for counting leucocytes Note the markings 0 5 1 and 11 and the white bead

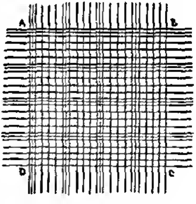


Fig 69—Thoma ruling of counting chamber as seen with ⅙ in lens. All cells in the area ABCD (1 sq mm.) are counted.

The *white cell pipette* (*Fig* 68) usually contains a white bead in its expanded part and has the markings 0 5, 1 0, and 11 The finger or ear is pricked and blood is drawn up to the mark (0 5 or 1 0, depending on circumstances) A diluting solution (consisting of 1 per cent acetic acid coloured with methylene blue) is then sucked up until the level of the fluid reaches the 11 mark Care must be taken that the fluid does not escape, and the pipette is carried with the ends closed by fingers The count must be made within an hour of collecting the blood

Before the diluted blood is transferred to the counting chamber the pipette is rolled and shaken for a couple of minutes to ensure thorough mixing About a third of the fluid is blown out and then a drop is allowed to run in under the cover-slip of the counting chamber, and the cells are allowed to settle for five minutes

If the counting chamber is of the *Thoma type* (*Fig* 69), all the leucocytes in the whole of the cross ruled area are counted Now if the blood has been diluted ten times (i e, the blood was drawn up to the 1 0 mark and diluted to the 11 mark), then the total number of white cells per c mm of blood is the figure multiplied by 100 (The area counted is 1 sq mm, the volume $\frac{1}{10}$th of a c mm and the dilution of blood 1–10)

Differential Count —The blood smear must be stained The smear is made on a slide free from grease An unused slide is first wiped free from dust A medium sized drop of blood is placed at one end of the slide and the end of another slide is placed over the drop, and is moved along to make the smear (*Fig* 70) The more acute the angle formed by the spreading slide to the smeared slide, the thinner will be the film of blood When dry, the film may be stained with Leishman's or Jenner's stain

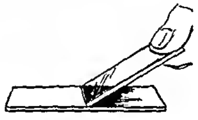


Fig 70 —Making a blood smear

Leishman's stain Cover the slide with the stain After a minute or two, add the same amount of distilled water and mix well After at least five minutes, wash off the stain with distilled water and leave the water on the slide until the film has a rose-pink appearance The slide is then allowed to dry

The secret of good Leishman and Jenner staining lies in the distilled water The acidity of distilled water varies, but by watching the blue colour fading, one arrives at the necessary time to allow the distilled water to remain in contact with the film

Jenner's stain The slide is covered with the stain and left for about half an hour The stain is then washed off and distilled water allowed to remain in contact with the smear until a satisfactory differentiation is obtained Usually, it is found that a minute or two is all that is necessary

In making the differential count on the smear, it is advisable to count the white cells across the breadth of the smear, i e, do *not* move the slide along its long axis Polymorphonuclear cells tend to congregate at the edge of the smear, so that to obtain a representative count the cells in the centre of the smear must be counted as well as those at the edge

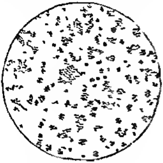
EXAMINATION OF PUS

Little information can be gained from a naked eye examination of pus Bubbles of gas in a wound discharging pus should lead to an investigation for the presence of a bacillus of the gas gangrene group

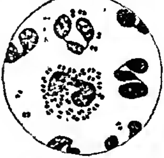
'*Sulphur*' *granules* (actinomycosis) may be seen, but more often their presence is looked for after the smear has been examined The granules can be demonstrated by adding a small amount of pus to some saline in a test-tube and shaking 'Sulphur' granules sink *rapidly*, they can be picked out from the bottom of the tube, and smeared and stained by Gram's method These granules must not be confused with the small pieces of thick pus that sink *slowly*

Microscopical Examination of Pus (*Fig* 71) —This should be undertaken in a 'wet' preparation A drop of the pus is placed upon a slide and mixed with a drop of methylene blue The mixture is covered with a coverslip and examined with the $\frac{1}{6}$-in objective After two minutes the nuclei of the polymorphonuclear cells (the so-called 'pus cells') take up the stain

Cholesterol crystals may be present If epithelial cells are present also and the ' pus ' has been evacuated from the neck, the evidence should lead one to suspect that the ' pus ' has come from a branchial cyst

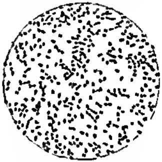


Staphylococcus pyogenes aureus



Gonococcus in pus

Bacillus welchii, the bacillus of gas gangrene



Bacillus coli communis

Streptococcus of scarlet fever

Bacillus tuberculosis (hominis) in sputum

Fig 71—Illustrations of micro-organisms (*Copyright of Messrs Burroughs Wellcome & Co (The Wellcome Foundation Ltd). Reproduced by kind permission*)

Smears—In order to find out what organisms are present in the pus, a smear s made on the slide A loopful of pus is spread very *thinly* on a slide A thick mear is useless A smear can also be made by placing a drop of pus at one end

of a slide Another slide is placed on top of the bead of pus and the two slides are drawn apart in opposite directions The smear is stained by one of the following methods —

Gram's method Cover for fifteen to thirty seconds with methyl violet or crystal violet Wash off with Gram's or Lugol's iodine and leave the iodine on for about one to one and a half minutes Wash off the iodine with alcohol (or industrialized methylated spirit), and allow the alcohol to remain in contact until no more violet stain comes away Wash off in water and counterstain with neutral red or weak carbol-fuchsin for ten to twenty seconds Wash off the counterstain with water, blot, and dry

Ziehl-Neelsen's method Cover the whole slide with a liberal amount of specially prepared carbol-fuchsin stain Heat the slide until it 'steams' Keep it heated gently for about ten minutes, but do not allow the stain to dry Wash off with water and add alcohol or alcohol containing 1 per cent HCl (1 part HCl to 100 of alcohol) After five minutes, wash off the alcohol and add 25 per cent sulphuric acid Leave the acid on for at least fifteen minutes Wash in water and leave in water for about five minutes Add methylene blue to counterstain and leave for a minute or two Wash off the excess in water, blot, and dry

In a smear of pus stained with Gram's stain it should be possible to recognize, or at any rate suspect, the presence of streptococci, staphylococci, actinomycotic filaments, gonococci, and some Gram-positive bacilli, e g , *B welchii*, *B anthracis* Before a definite diagnosis can be made it is usually necessary to examine the culture

If no organisms are seen, the inference is that there are very few or possibly no organisms in the pus or that the organisms are not disclosed by the stain employed Tubercle bacilli are not as a rule found in large numbers in pus, and it may be necessary to examine many fields before a single tubercle bacillus is found

EXAMINATION OF MATERIAL FROM ULCERS

Crusts are removed and the ulcer is touched with a sterile swab stick (*see Fig* 64) During transport the swab stick is protected from contamination and is placed on the surface of a routine culture medium, e g , nutrient agar or blood-agar The material on the swab stick can still be used to make a smear on a slide The latter is stained with Gram's stain or methylene blue The cultures are examined twenty-four hours later

Ulcers of the Mouth and Tonsils.—Several swab sticks should be used and cultures made on Klebs-Loeffler's medium (inspissated serum) as well as on agar or blood-agar Smears are stained with Gram's stain If diphtheria is suspected, one of the stains specially used for the Klebs-Loeffler bacillus, e g , Albert's or Pugh's stain, must be employed

If Vincent's angina is a possibility, weak carbol-fuchsin (5 per cent), placed on the smear for a minute or two and then washed off, will show up the fusiform bacilli and spirochætes found in this infection Carbol-fuchsin or methylene blue will also reveal the presence of monilia (yeasts)—egg-shaped bodies rather larger than a pus cell or red blood-cell Numbers of these organisms are found when thrush is present

Ulcers on the Penis.—The most likely diagnosis is a chancre, and the technique of examining for the *S pallida* is as follows The ulcer is swabbed with a piece of cotton-wool soaked in spirit The spirit is allowed to dry and serum will then be seen to ooze from the surface of the ulcer This is collected in a very fine capillary tube, and is examined by dark-ground illumination—a procedure which requires experience

III. TABLE OF LABORATORY NORMALS

HÆMOGLOBIN —
100 per cent (Haldane standard)
80 per cent (Sahli standard)

WHITE BLOOD-CELLS — 5000 to 10,000 per c mm
Polymorphs, 60 to 70 per cent.
Lymphocytes, 20 to 30 per cent
Monocytes, 4 to 8 per cent
Eosinophils, 2 to 4 per cent
Basophils, 1 per cent

DISTRIBUTION OF EUROPEANS IN THE FOUR BLOOD GROUPS —
Group (AB) I, 5 per cent
Group (A) II, 41 per cent
Group (B) III, 12 per cent
Group (O) IV, 42 per cent

BLOOD UREA — 20 to 40 mg per 100 c c

BLOOD SUGAR — 80 to 120 mg per 100 c c

CALCIUM — 9 to 11 mg per 100 c c

PHOSPHATE (INORGANIC) — 2 to 4 mg per 100 c c

PHOSPHATASE — Up to 5 units

URIC ACID — 2 0 to 3 5 mg per 100 c c

ICTERUS INDEX — 4 to 6 units

URINE —
Specific gravity, 1010 to 1025
Reaction, *p*H 4 8 to 7 6

VAN DEN BERGH TEST —
Positive Immediate Direct — Obstructive jaundice
Positive Indirect — Jaundice from disease of the liver cells, e g , hæmatogenous

CHAPTER VI

EXAMINATION OF THE URINE

By E G B Calvert

The urine of all new cases should be examined, whether the presence of abnormalities in it be suspected or not This chapter contains a brief account of the more important tests and their significance

The Specimen for Examination—As variations occur in the composition of the urine during the day and night, it is best to examine a specimen from the total collection for the twenty-four hours, or one passed about two hours after a meal, otherwise certain abnormalities may not be found Thus, in a case of glycosuria, sugar is present in the urine obtained an hour or two after a carbohydrate meal, but it may be absent from samples collected either before breakfast or at other times when the patient has been without food for several (four or more) hours Often the comparison of a number of separate specimens is of diagnostic value—for example, in cases of orthostatic albuminuria, where albumin is absent from the early morning urine, also in cases of advanced chronic nephritis, where there is little alteration in the specific gravity, from one specimen to another, throughout the twenty-four hours, in contrast to the widely varying density of normal urine

Examination of the urine may be divided into (I) Physical, (II) Chemical, and (III) Microscopical

I. PHYSICAL EXAMINATION

The following should be noted (1) Volume, (2) Colour and transparency, (3) Odour, (4) Consistence, (5) Specific gravity, (6) Nature of any deposit which may occur on standing

1. Volume—The healthy adult passes on an average 50 oz (approximately 1500 c c) of urine in the twenty-four hours, but there may be considerable physiological variations, depending on the fluid intake, the state of the bowels, the temperature of the skin, and other factors

The day urine (twelve hours) should be measured separately from the night urine Normally, the volume of the latter is about one-fifth to one-third of the former When kidney function is defective, as in chronic nephritis, the volume of the night urine approximates to that of the day urine, and may equal or even exceed it

Increase in the volume of urine, if persistent to any degree, usually indicates some pathological condition—for example, polyuria is found in diseases of the vascular-renal system associated with high blood-pressure, also in diabetes mellitus, diabetes insipidus, and certain forms of hysteria

Abnormal decrease in the output of urine occurs when the arterial pressure is lowered, as in some forms of myocardial failure and in cases of cerebral irritation and shock following injuries, or when the venous pressure in the kidneys is raised, as in congestive heart disease and acute nephritis Very marked

diminution is also observed in subacute nephritis, nephrosis, ureteric obstruction, diarrhœa and vomiting, and in all fevers

Suppression of urine may occur at the beginning of acute nephritis, or may result from irritation in the urinary tract—for example, from a stone in the renal pelvis or an injury to the urethra

2. **Colour and Transparency**—Normal urine is of a pale lemon or straw colour, but the depth of tint varies greatly, depending on the degree of dilution and on the reaction Other things being equal, the more acid a urine the deeper is the colour

Red or smoky urine suggests the presence of blood, while a yellowish green to brownish one is associated with jaundice

The urine becomes orange-coloured when urobilin is present in considerable quantity, as in cases of defective liver function or of severe hæmolysis Urobilin is not present in fresh normal urine, but a trace may appear on standing, being derived from its precursor, urobilinogen Urine containing an excess of urobilinogen or urobilin gives a bright red colour when 2 drops of a 3 per cent solution of paradimethylaminobenzaldehyde in 50 per cent HCl are added to 5 c c of the specimen The colour may take a few minutes to develop Before deciding that a test is negative it is advisable to warm the solution A clearly positive results indicates impairment of biliary function

Carbolic acid urine and the urine of the rare condition known as alkaptonuria gradually become dark on exposure to air, due to oxidation changes In carbolic acid poisoning the urine may be olive green when passed

The taking of rhubarb or senna often makes the urine an orange or a reddish brown colour, pyramidon makes it a reddish-orange or cherry-red, salol a darkish green, santonin a greenish-yellow or yellow, pyridium a reddish-orange, methylene-blue (sweets and pills) a green to blue, eosin (sweets) a fluorescent pink, prontosil rubrum a bright blood red, antipyrin a reddish colour suggesting the presence of blood

The urine, normally, is clear when passed At room temperature a faint cloud of mucus settles out Turbidity or opalescence of a specimen is due to various substances in suspension If this persists after thorough filtration then bacteria are present

3 **Odour**—In decomposing urine the odour is ammoniacal, and in ketonuria fruity Turpentine (which imparts the smell of violets), asparagus, santonin, and cubebs produce other departures from the normal Communication between the bowel and the urinary tract causes a fæcal odour

4 **Consistence**—An alkaline urine containing pus tends to be ropy Much sugar or bile lessens the mobility of the urine, and urine containing albumin or bile is more frothy than normal

5 **Specific Gravity**—This is taken with a urinometer, graduated for a temperature of 15° C The normal range for the twenty four hour specimen is from 1015 to 1025, but higher or lower figures may be found in health Readings should be made at room temperature (15 to 20° C), as the density of warm freshly-voided urine is increased appreciably by cooling Normally, there is considerable fluctuation of specific gravity, from one specimen to another, throughout the twenty four hours, but in chronic nephritis a certain degree of fixation occurs and at a low level (near 1010 in the worst cases) if no œdema is present Sugar in the urine raises the specific gravity In untreated diabetes mellitus the readings may be as high as 1060, but are usually between 1025

and 1050 Exceptionally low figures, for all samples, is the rule in diabetes insipidus

6 Deposits —Mucus, phosphates, urates, and free uric acid are the normal urinary constituents which may settle as a deposit easily visible in a conical glass

Mucus —A cloud of mucus will sink if the urine is dilute, but will float if the urine is very concentrated

Phosphates —The phosphates of calcium and magnesium (earthy phosphates) are deposited in alkaline or neutral urines The disappearance of the deposit on the addition of acetic acid distinguishes it from that of pus The diagnosis of the latter, however, must only be made by microscopical examination

Uric Acid and Urates —In acid, concentrated urines—for example, in fevers and congestive heart failure—the urates of sodium, potassium, and ammonium may form, on cooling, a red brick amorphous ('brick dust') deposit The colour is due to urinary pigments which have been carried down at the same time Where there is little pigment, as in the urines of women and children, the deposit may be yellowish or whitish All varieties are easily recognized by their disappearance on heating the specimen The heating should be gradual in order to avoid clouding by any albumin which may be present Urates are dissolved by strong nitric acid, but not by acetic acid

In very acid urines a small amount of free uric acid may be deposited, and is found in the form of red or dark brown crystalline grains—known as the 'cayenne pepper' deposit

Uric acid separating out, either in the crystalline or amorphous state, in the urinary tract constitutes the condition referred to as 'gravel', sometimes a calculus is formed

The deposition of salts, or their acids, in the urine does not mean that these salts or their acids are necessarily in excess, but merely that the factors which ordinarily keep them in solution have been altered Thus, a high degree of acidity and a deficiency of pigment and salts are conducive to the sedimentation of uric acid, though excess of the latter is also a factor

Uric acid occurs in small quantities in normal urine, mainly as a urate of sodium Its output is increased in febrile conditions, acute gout, and after the administration of certain drugs—for example, salicylates, but especially after cinchophen and other derivatives of quinoline carboxylic acid There is a physiological increase in uric acid excretion when excessive amounts of protein, particularly nucleo-protein, are consumed In leukæmia, where there is great destruction of leucocytes, the output is usually very high

II CHEMICAL EXAMINATION

This consists of (1) Taking the reaction of the urine, (2) Testing for abnormal constituents, (3) Estimating, in certain tests of renal function (*see* Chapter XXXIII), the percentage of urea

REACTION OF THE URINE

The urine is generally acid to litmus, but it may normally be alkaline for some hours after meals—the so-called 'alkaline tide' In decomposing urine the reaction is alkaline, due to ammonia The ammonia may be recognized by its smell and by the dispersal by heat of the blue colour obtained with red litmus paper

The reaction should be taken when the specimen is fresh, as an acid urine may become alkaline from bacterial decomposition within a few hours

In treating urinary infection with alkalis the early morning sample ought to be tested, as the night urine is the most difficult to make alkaline When this turns litmus blue (pH over 7 0) then sufficient alkali is being given

In the mandelic acid treatment of urinary infection the urine is made acid to the point of lowering the pH below 5 3

The normal range of pH in the urine is from 4 8 to 7 4 (average 6 0), and this can be covered by the following four indicators B D H '4460'—i e, improved methyl red (4 4 to 6 0), brom-cresol purple (5 2 to 6 8), brom thymol blue (6 0 to 7 6), and phenol red (6 8 to 8 4) The important one, of course, for the mandelic acid treatment is the B D H '4460', which produces colours varying from green, through yellow and orange, to red as the urine becomes more acid

The colorimetric measurement of the urinary pH is easily carried out by means of the Lovibond comparator

Briefly, this method consists in placing 10 c c of fresh urine (filtered or centrifuged, if not clear) in one of the comparator tubes, adding 0 5 c c of the indicator solution, mixing, and then comparing the colour obtained with that of a tube of untreated clear urine upon which is superimposed one or other of a series of coloured glass discs, the latter are graded in depth of tint to represent the pH range of the indicator in steps of 0 2 pH When the colours are matched the pH value of the urine is read off from the disc. The comparator, indicator solutions, and details of the technique may be obtained from The British Drug Houses Ltd, London

ABNORMAL CONSTITUENTS

The following are the abnormal constituents most frequently found in the urine (1) Proteins—(*a*) albumin, (*b*) proteose, and (*c*) Bence-Jones protein, (2) Sugars, (3) Acetone bodies, (4) Blood, (5) Bile, (6) Pus, (7) Glycuronic acid

1 Proteins —

a ALBUMIN —There are three groups of albuminuria—the benign, the febrile or toxic, and the organic —

Benign Albuminuria —Also described as physiological, functional, postural, orthostatic, or cyclical It occurs mostly in rapidly growing and poorly developed children, especially boys, and is often associated with lordosis The morning urine, or the urine after a day or two in bed, is free from albumin, but not the urine collected when the patient is up and about. The albuminuria following strenuous exercise, mental strain, or exposure to cold is also benign in nature Venous congestion in failing heart conditions may cause a temporary albuminuria, and the urine, unlike that of nephritis, is usually loaded with urates Congestion also probably accounts for the transitory albuminuria frequently present after an epileptic fit

Febrile or Toxic Albuminuria —This may be classed as intermediate between the benign and the organic, for if the toxic action is prolonged an organic lesion may be established

Organic Albuminuria —May be due to many causes—for example, all forms of nephritis, lipoid and amyloid nephrosis, infarction, tuberculous disease, malignant growths, pyelitis, cystitis, urethritis, and stones anywhere in the urinary tract

Tests for Albumin —If the urine is not quite clear it should be filtered, a second filtering may be required Turbidity then generally means infection. The turbidity may be removed by shaking up with a little powdered barium carbonate and filtering again

Boiling test This is a reliable test Place about an inch of the clear urine in each of two test-tubes Use one as a control, bring the other to the boil If clouding occurs it may be due to albumin or earthy phosphates Add a few drops of 5 per cent acetic acid, when clouding from phosphates will disappear, but that from albumin will remain If, on the other hand, no clouding occurs after the boiling, it is still necessary to add the acetic acid, a cloud now indicates albumin, and a clear urine means that no albumin is present Always add the acid after boiling, whether clouding occurs or not

The test can be carried out in one test-tube by two-thirds filling it with urine and boiling the upper portion, the lower part being used as a control

Salicyl-sulphonic acid test A saturated solution of salicyl sulphonic acid is used The test is a very delicate one, easy to carry out, and the solution is non corrosive

Into each of two test tubes put an inch or so of urine, cleared, if necessary, in the way already mentioned One tube is used as a control, into the other put a few drops of the solution Clouding indicates albumin or proteose, but with proteose the cloud disappears on heating and reappears on cooling

Quantitative estimation of albumin This is done in Esbach's albuminometer The urine must be made clear and acid, if not already so If the specific gravity is over 1008, add water to bring it to this figure Fill the special test-tube with the urine to the mark U, and add Esbach's reagent (picric acid 10 g, citric acid 20 g, and distilled water 1 litre) to the mark R Close the tube with a rubber stopper, mix gently, leave in the upright position for twenty-four hours, and then read off the level of the precipitate The figures represent grammes of dried albumin per litre of urine To get the percentage, divide by 10 If necessary, correct for dilution by multiplying by the number of times the urine was diluted The method is sufficiently accurate for clinical work

b PROTEOSE —This is a metabolic product of protein, which on further breakdown yields peptone *Proteose may appear in the urine during the resolution of a lobar pneumonia, in acute yellow atrophy of the liver, during involution of the uterus, in extensive suppuration, or in any other condition where marked autolysis of the tissues is occurring* Proteosuria is probably most common in cases where much pus has collected in the body—for example, in empyema Proteose is distinguished from albumin by its not being coagulated by heat, and by the fact that its precipitate with salicyl-sulphonic acid disappears on heating

c BENCE-JONES PROTEIN —This protein is almost invariably found in the urine of patients suffering from multiple myelomata Its presence is practically pathognomonic of the disease, and leads to a diagnosis before any swellings on the bones are noticed The Bence-Jones protein is recognized by its precipitation at 40 to 55° C and its solution again about boiling point

2. **Sugars** —*Several sugars appear in the urine, but only glucose and lactose are of general clinical interest*

GLUCOSE —This is by far the most common sugar found in the urine Although glucose in the urine (glycosuria) is one of the chief findings in diabetes mellitus, it must be clearly understood that every patient with glycosuria has not necessarily got diabetes mellitus For an account of diabetes and its differential diagnosis a text-book on the subject should be consulted

Tests for Glucose —

Fehling's test To half an-inch or so of Fehling's No 1 solution in a test-tube add an equal quantity of the No 2 solution and mix. Then add about one quarter inch of urine (freed of albumin), mix again, and boil If the urine contains any considerable quantity of glucose a yellow or red precipitate of cuprous oxide will appear, with less glucose the precipitate is greenish If no reaction, then add more urine until almost as much is present as Fehling's solution and boil again Should no precipitate occur on cooling, it may be concluded for clinical purposes that glucose is absent

To free the urine of albumin for the test, add a few drops of 5 per cent acetic acid, boil, and filter

side of the E line) To obtain the D line Sprinkle sodium chloride into a bunsen flame which is being viewed through a spectroscope

'Reduced' hæmoglobin spectrum shows a single broad darkish band, with ill-defined edges, *lying between the D and E lines, sometimes it extends to the red side* of the D line The addition of a few drops of ammonium sulphide will change the spectrum of oxyhæmoglobin to that of 'reduced' hæmoglobin

Methæmoglobin spectrum shows the characteristic narrow dark band in the red (between C and D), a few drops of ammonium sulphide will remove the band

Hæmochromogen spectrum shows a very dark band midway between D and E, and another dark band almost on the E line

HÆMATURIA —Blood intimately mixed with the urine passed suggests a renal origin When it comes from the bladder it often appears at the end of micturition, when from the urethra it appears at the beginning of the act The

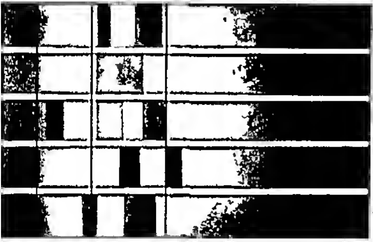


Fig 72 —Spectra of hæmoglobin and hæmoglobin derivatives

colour of the specimen varies with the amount of blood present. The urine may be very dark, or the presence of blood may not be detected by the naked eye If renal bleeding is slight the colour is 'smoky'—largely due to the conversion of hæmoglobin to methæmoglobin Red blood-corpuscles form red or brown deposits

Causes of Hæmaturia —The causes of hæmaturia are numerous—for example —

a Systemic affections Hæmorrhagic fevers, scurvy, purpura, leukæmia, erythræmia, and hæmophilia

b Renal affections Nephritis, papilloma and other new growths, calculus, hydronephrosis, polycystic disease, tuberculosis, infarction (for example, from septic endocarditis), congestion from heart failure, rupture of glomerular vessels in hypertension, oxaluria, pyelitis, angioma and nævi of the renal pelvis, and from the action of certain drugs, such as turpentine, cantharides, carbolic acid, and hexamine

c Affections of the urinary passages Calculus, papilloma and other new growths, tuberculosis, bilharziasis, varix, cystitis, prostatitis, vesiculitis, urethritis, polypi, caruncle, granulations, and stricture

d Lesions of adjacent organs or tissues and injuries affecting the urinary tract.

HÆMOGLOBINURIA.—Methæmoglobin is the usual pigment found, and is recognized by its spectrum (*see Fig* 72) Hæmoglobinuria is the result of some hæmolytic action

It may be due to chemical substances like potassium chlorate, quinine, naphthol, and arseniuretted hydrogen, or may be due to malaria (blackwater fever), syphilis, toxæmia from severe burns, or incompatibility in blood transfusions

Paroxysmal hæmoglobinuria occurs mostly in patients with Raynaud s disease, especially where the Wassermann reaction is positive, and in young persons with congenital syphilis Attacks follow exposure to cold, particularly during exertion

HÆMATOPORPHYRINURIA —This sometimes occurs in patients, generally females, who are taking sulphonal, or perhaps trional The passage of the characteristic port-wine-coloured urine, in such cases, indicates a severe, and often fatal, poisoning The pigment may be recognized spectroscopically—a narrow band on the D line and a broad band between the yellow and the green (*see Fig* 72) A rare congenital form of hæmatoporphyrinuria is associated with hydroa æstivale

5. **Bile** —Bile-pigment is found in the urine of all forms of jaundice resulting from obstruction of the biliary passages In the fresh specimen of urine the pigment present is bilirubin, but this may change gradually to biliverdin on standing Urine containing bile is yellowish-green to brownish in colour, and is more frothy than normal The froth is bile-stained, whereas that of drug-coloured and normal urines is whitish

Tests for Bile —

Nitric acid test Place some urine on a filter-paper, or, better still, filter the urine several times through a filter-paper, and then add a drop of yellow concentrated nitric acid A rainbow ring of colours will result if bile is present Of these colours the green (biliverdin) is alone characteristic of bile

Iodine test Use a 10 per cent alcoholic solution of iodine, or tincture of iodine diluted with alcohol until it is light reddish-brown in colour Place the urine in a test tube and pour the iodine solution slowly down the side of the tube, a green layer forms at the junction of the two liquids if bile is present

Test for Bile-salts —

Hay's sulphur test Some powdered sulphur is sprinkled on the surface of the specimen of urine With normal urine the sulphur will float, but if bile salts are present it will sink

Apart from a possible exception in some cases of nephritis, the presence of bile-salts in the urine is always indicative of liver damage or bile-duct obstruction

Test for Urobilinogen or Urobilin —*See* p 40

6. **Pus** —Pus may come from the kidney, pelvis of the kidney, ureter, bladder, prostate, or urethra If present in the urine in small quantity it may be recognized only by means of the microscope When in considerable amount it may form a light-coloured deposit which is readily diffused on shaking

Tests for Pus —Pus is not soluble in acetic acid, and this differentiates it from phosphates, also, the addition of a little caustic potash solution converts it into a ropy gelatinous mass

Fresh ozonic ether, or fresh hydrogen peroxide, mixed with pus, causes an effervescence of oxygen

As mentioned already (*see* p 45), pus generally gives with tincture of guaiac alone a greenish or bluish-green colour, which disappears on heating

In all cases, however, the diagnosis of pus in the urine must only be made by microscopical examination

7. **Glycuronic Acid.**—This is a product of the incomplete oxidation of glucose, and is used in metabolism to detoxicate phenols, alcohols, and aromatic acids Normal urine contains a trace, but always in combination as a glucoside For example, compounds are formed with bodies like phenol, indoxyl, and skatoxyl, and therefore the output is increased in intestinal stasis In similar manner, comparatively large amounts of glycuronic acid are excreted in combination with drugs such as camphor, aspirin,

chloral, benzoic acid, antipyrin, oil of turpentine, menthol, chloroform, and morphia, but with some of these the dose must be fairly large On the assumption that the conjugation of glycuronic acid occurs in the liver, camphor and aspirin have each been used to test hepatic function—failure to find the compounds (glycuronates) in the urine indicating very serious damage On the other hand, glycuronates often appear, quite apart from giving drugs, in considerable quantity in the urine in chronic obstructive jaundice, and if, as in the case of drug glycuronates (*see* p 44), Fehling's solution should be reduced, it is the glycuronic acid component which is responsible However, unlike glucose, glycuronic acid does not reduce Benedict's solution or ferment yeast

ESTIMATION OF THE PERCENTAGE OF UREA IN THE URINE

The percentage of urea is conveniently estimated by using Gerrard's ureometer (*Fig* 73)

The apparatus consists of a calibrated burette (*b*) attached to a reservoir (*c*) which can be raised or lowered The top of the burette is connected by rubber tubing to a bottle (*a*) With the clip (*d*) open, water is poured into the reservoir (*c*) until, with (*c*) raised, the surface of the water in the lower part of (*c*) is on a level with that of the water in (*b*) at the mark zero Then 25 c c of 40 per cent caustic soda is placed in bottle (*a*) and 2 c c of bromine added, thus producing a fresh sodium hypobromite solution.

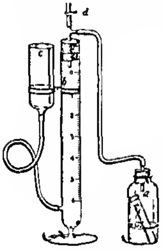


Fig 73 —Gerrard's ureometer

Albumin, if present in the urine, should be removed by adding a few drops of 5 per cent acetic acid to 20 c.c. of the specimen, boiling, and filtering The volume is then made up to the original 20 c c by the addition of distilled water

Measure 5 c.c. of the urine into the special small tube provided, and lower this tube into the hypobromite solution in (*a*) without spilling any of the urine Tightly stopper (*a*) and close (*d*) Now mix the 5 c c of urine with the hypobromite solution by tilting (*a*) Nitrogen is liberated and the water in (*b*) is displaced downwards Cool (*a*) in cold water for a few minutes, and then, by lowering (*c*), bring the water in (*c*) and (*b*) to the same level The reading of the level in (*b*) will give the percentage of urea in the urine (grammes per 100 c c) The method is accurate enough for clinical purposes

If the burette is marked in c c , instead of being calibrated as above, the percentage is obtained by multiplying the number of c c of nitrogen given off from the 5 c c of urine by 0·056

Urea is the chief nitrogenous waste product found in the urine, and ordinarily represents 80 to 90 per cent of the total nitrogen found there, but if the person is on a low-protein diet it may represent only 60 per cent Normally the urea output varies greatly with the diet, and is highest when large amounts of protein are consumed Thus the amount excreted by a normal adult may be as much as 40 g in the twenty-four hours, or as little as 20 g , but it is usually about 30 g , and with an average concentration of 2 per cent Muscular exertion and marked mental activity increase the excretion of urea Pathologically it is increased in fevers and in diabetes mellitus, and decreased in acute yellow atrophy and cirrhosis of the liver and in Bright's disease

III MICROSCOPICAL EXAMINATION OF THE URINE

This is of great importance, it may provide the first evidence of disease of the urinary tract, or may decide the question of a doubtful diagnosis

A centrifuge may be used to facilitate the collection of deposits

Classification.—The following is, more or less, the usual classification of the subject —

1 UNORGANIZED DEPOSITS —
   a Crystalline and Amorphous Deposits found in Acid Urine—Uric acid, amorphous urates, calcium oxalate, cystin, leucin and tyrosin, hippuric acid, creatinine, and calcium sulphate
   b Crystalline and Amorphous Deposits found in Alkaline Urine—Calcium phosphate (amorphous and 'stellar'), ammonium magnesium (or 'triple') phosphate, ammonium urate, calcium carbonate, and magnesium phosphate
      In (*a*) and in (*b*) the first three are common, the others rare
   c Other Unorganized Deposits found in Acid, Neutral, or Alkaline Urine—Cholesterol, fat, hæmatoidin, indigo, and melanin
2 ORGANIZED DEPOSITS—Red blood-corpuscles, leucocytes and pus cells, epithelial cells, tube casts, also, prostatic threads, spermatozoa, fibrin, blood clots, mucus-corpuscles, mucus-threads, mucus-casts (known also as cylindroids), and connective tissue
3 MICRO-ORGANISMS AND ANIMAL PARASITES
4 FOREIGN BODIES

UNORGANIZED DEPOSITS

Crystalline and Amorphous Deposits Found in Acid Urine —

Uric Acid—This has already been mentioned as forming, to the naked eye, the 'cayenne pepper' deposit (*see* p 41) Microscopically, uric acid is seen to consist of yellowish-brown or reddish-brown crystals, mostly of the whetstone or rhombic-prism type (*Fig* 74, A) Variations in colour are due to the amount of pigment in the urine and to the thickness of the crystals—for example, thin plates may be light-yellow or almost colourless Crystals are frequently arranged as rosettes, crosses, sheaves, combs or brushes, irregular plates, and other formations

Amorphous Urates (mostly sodium urate)—These, whether pigmented ('brick-dust' deposit) or colourless, dissolve on heating Microscopically they appear as moss-like masses of minute amorphous granules In very rare instances sodium urate is crystalline, and in the form of small fans or clusters of fine needles

Calcium Oxalate—This is found as small, colourless, highly refractive octohedra, not unlike envelopes (*Fig* 74, C), but may appear also as small dumb-bells Calcium oxalate crystals are apt to occur in the urine after the ingestion of rhubarb, strawberries, spinach, or sorrel It is not uncommon to find them in cases of dyspepsia, neurasthenia, or chronic pancreatitis Oxaluria is occasionally responsible for recurrent hæmaturia or for pain suggesting renal calculus

Cystin—Cystin is a sulphur-containing amino-acid, which is rarely found in the urine in more than minute traces Sometimes it occurs in considerable amounts in the urine in several members of the same family, and may be hereditary With the increased excretion a fawn-coloured deposit may form Microscopically, this appears as hexagonal plates (*Fig* 74, G) A cystin calculus may develop if urinary infection is present

Leucin and Tyrosin—These usually occur together and are mostly found when there is rapid destruction of liver tissue, as in acute yellow atrophy of the liver, phosphorus poisoning, and yellow fever, also occasionally in typhoid fever, small pox, erysipelas, scarlet fever, and leukæmia

Leucin is in the form of yellowish or brown spherical masses with concentric markings, tyrosin in the form of clusters or sheaves of fine needle-like crystals (*Fig* 74, E, F) They may resemble fat-globules and fat-crystals respectively, but are distinguished by being insoluble in ether Leucin and tyrosin are never seen in normal urine

Hippuric Acid—This is the only normal urinary constituent which is produced by the kidney itself, it is synthesized from benzoic acid and glycine When the excretion of hippuric acid is increased by the administration of benzoic acid or benzoates, or by a vegetable diet, a deposit of colourless plates and prisms may occasionally form These somewhat resemble 'triple' and 'stellar' phosphates, but appear in acid urine and are not soluble in acetic acid

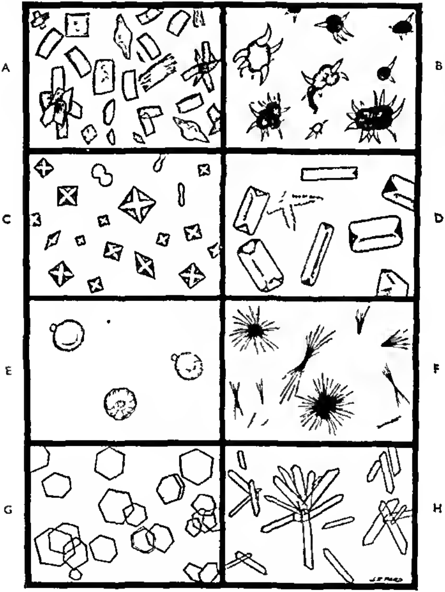


Fig 74—Microscopical characters of crystalline urinary deposits A Uric acid B Ammonium urate C, Calcium oxalate D, Ammonium magnesium phosphate E, Leucin F, Tyrosin. G Cystin H, Stellar phosphates

Creatinine.—Creatinine sediments are rare, and occur chiefly after prolonged muscular exertion, but also in severe acute nephritis, typhoid fever, and pneumonia. The formation consists of colourless barrel shaped and whetstone-shaped plates and prisms.

Calcium Sulphate.—Crystals of calcium sulphate resemble 'stellar' phosphates, but occur in acid urine. They are rare, and their clinical significance unknown.

Crystalline and Amorphous Deposits Found in Alkaline Urine.—

Calcium Phosphate.—There are two varieties, amorphous and crystalline (or 'stellar' phosphate).

Amorphous calcium phosphate deposits are white and flocculent and dissolve with acetic acid. Microscopically, minute colourless granules are seen. These may be in masses of various sizes, but not in moss-like arrangement as in the case of urates.

Crystalline calcium phosphates ('stellar' phosphates) occur in star-shaped clusters of colourless prismatic crystals or singly (*Fig.* 74, H). They are frequently found with 'triple' phosphates, but otherwise are uncommon.

Ammonium magnesium Phosphate ('triple' phosphate).—These deposits appear in ammoniacal urines. Microscopically, they consist of large prismatic rhombic crystals—described as 'knife-rest' crystals (*Fig.* 74, D). If the urine is excessively ammoniacal there may be irregular plates, or fern-like or 'feathery' forms.

Ammonium Urate.—Deposits are often found in alkaline urine, and especially in association with those of calcium phosphate and 'triple' phosphate. Microscopically, small rounded spinous masses are seen (*Fig.* 74, B).

Calcium Carbonate.—This is occasionally found as a deposit in the urine, alone or with phosphates, and occurs mainly in cases of bone disease and after drinking large quantities of certain mineral waters. Calcium carbonate is dissolved by acetic acid and the evolution of gas distinguishes it from phosphates. The deposit consists usually of small, amorphous, highly refractive granules; sometimes small dumb-bell shapes are seen.

Magnesium Phosphate.—Crystals of magnesium phosphate may appear with calcium carbonate deposits, but are very rare. They take the form of colourless, highly refractive, small, quadrilateral prisms.

Other Unorganized Deposits Found in Acid, Neutral, or Alkaline Urine.—

Cholesterol.—Cholesterol has been found occasionally in the urine, chiefly in cases of chronic cystitis, nephrosis, and chyluria. It appears as colourless, thin, irregular, rhombic plates, often notched on the corners and sides. The deposit is dissolved in ether.

Fat.—In cases of chyluria the urine is turbid or milky, owing to the fat it contains. Microscopically, enormous numbers of fat-granules or fat-globules are seen, and usually some red blood corpuscles and pus cells. A careful search should be made in the urine and blood, especially in night specimens, for the *Filaria sanguinis hominis* which almost always is the cause of chyluria.

Lipuria (that is, fat in the urine) may also be found in the lipæmia of diabetes, chronic inflammation of the urinary passages, neoplasms of the kidney, phosphorus poisoning, pregnancy, and after the liberation of fat into the circulation by the fracture of long bones. The fat-globules are not only free in the urine but also often appear within epithelial cells and pus cells and on the surface of tube casts. They have a dark contour, refract light strongly, and vary considerably in size; the larger ones may occasionally contain, or be accompanied by, extremely thin needles of fat. Cholesterol plates occur in a small proportion of cases.

Sometimes the presence of fatty or oily matter in the urine may be traced to the lubrication of a catheter, or to the accidental or deceitful addition of milk or other fatty or oily liquid to the specimen

Hæmatoidin —Crystals of hæmatoidin are derived from old blood-clots, and appear as small, rust brown, irregular plates or masses, which are often surrounded by fine needles, attached in cilia fashion The needles may also be lying free, or joined together in stellate, dendritic, or brush like figures

Indigo —Indigo is a decomposition product of indican It occurs mostly in putrid urine, and is seen as small, bluish, rhombic crystals, or as needles or irregular masses

Melanin —This is sometimes found in the urine in cases of melanotic tumours as small, dark brown or black, irregular masses or granules The intravesical use of silver salts may produce black particles of similar appearance

ORGANIZED DEPOSITS

Red Blood-corpuscles (*Fig* 75, B 3)—These are recognized by their shape and colour Considerable alterations may occur, however, in their appearance, depending on the length of time they have been in the urine, and for other reasons, they may be swollen, lacking in colour, crenated, or shrunken

Leucocytes and Pus Cells (*Fig* 75, B 1, 2)—Leucocytes occurring as part of a hæmorrhage must not be mistaken for pus cells The presence of the latter indicates inflammatory changes in the urinary tract, but in women the possibility of contamination from the vagina must be excluded In acid urine the cells usually retain most of their ordinary appearance, but in alkaline urine they are swollen and opaque, and require the addition of acetic acid to bring the nuclei into view

Epithelial Cells —Apart from a few superficial cells from the bladder, and also, in the female, a certain number from the vagina, the presence of epithelial cells in the urine is pathological and particularly so if accompanied by pus cells

Epidermal scales from the prepuce in the male, and the clitoris and labia in the female, are frequently found, but are easily differentiated from epithelial cells, the scales have a shrunken appearance, are highly refractive, and do not contain a nucleus

The type of epithelium present in the urine will often indicate which part of the urinary tract is affected —

Renal Epithelium —As found in the urine, the cells from the convoluted tubules are round or slightly irregular (*Fig* 75, A 1), and those from the collecting tubules globular, both sorts are about one third larger than pus cells They do not require acetic acid for the delineation of their nuclei The finding of renal epithelium and pus cells in urine, excreted over a period of rest, means the existence of some pathological process in the kidney In the subacute and chronic forms of nephritis the epithelial cells show degenerative changes

Cells from the Renal Pelvis —These are mainly club shaped (*Fig* 75, A, 3), globular, or lenticular, some are quadrilateral, others irregular

Ureteric Cells —Found with those from the renal pelvis They are round or globular, or slightly irregular, and smaller than similar cells of pelvic origin They cannot be distinguished from the epithelial cells of the prostate

Bladder Epithelium —The lining of the renal pelves, the ureters, and the urethra, while of the transitional variety, does not show the three layers of typical cells distinctly as in the case of the bladder The superficial vesical cells are flat and quadrilateral (*Fig* 75, A 4), with concavities on the under surface into which fit the cuboidal cells of the middle layer, those of the deepest layer are

columnar or club-shaped (*Fig* 75, A 2) The latter, which are also present in places in the middle layer, are not distinguishable from the club shaped cells of the renal pelvis The rather large superficial flat cells and the cuboidal epithelium are, however, characteristic of the bladder Superficial cells joined together may often be seen

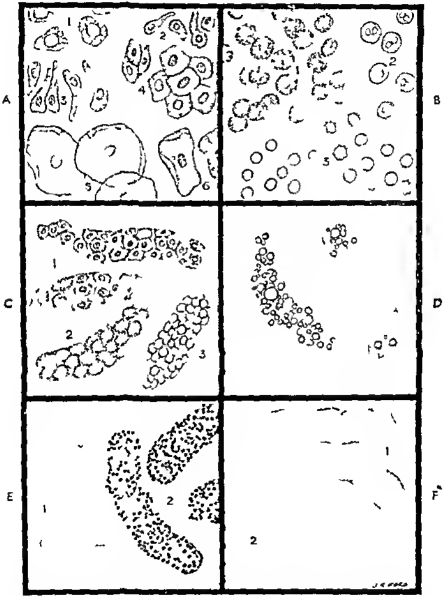


Fig 75—Microscopical characters of organized urinary deposits A Epithelium *from* (1) Renal tubules (2) Bladder (deep) (3) Renal pelvis (4) Bladder (superficial) (5) Vagina (6) Urethra. B. (1) Pus cells; (2) The same treated with acetic acid (3) Red blood-*corpuscles* C. Casts (1) Epithelial (2) Pus (3) Blood. D Casts fatty E Casts (1) Finely granular (2) Coarsely granular F Casts (1) Waxy, (2) Hyaline

Urethral Cells—These are flat (*Fig* 75, A 6), cuboidal, or club-shaped, and, as a rule, readily diagnosed by their comparatively large size and their irregularity of outline

Vaginal Epithelium—Vaginal epithelium, consisting of large squamous cells (*Fig* 75, A 5), is easily recognized

Tube Casts—These come from the uriniferous tubules of the kidneys, and may be hyaline, epithelial, granular, 'blood', 'pus', fatty, or waxy

Hyaline Casts (*Fig* 75, F 2)—These are translucent and somewhat difficult to detect unless iodine is added They occur in all kidney affections It should be noted, however, that in normal people the urine, even when excreted over a period of rest, may contain occasional hyaline casts and also a few red blood-corpuscles

Epithelial Casts (*Fig* 75, C 1)—Numerous in acute nephritis, and also in the subacute form They are hyaline casts studded with epithelial cells In acute nephritis the cells, though more or less coarsely granular, are intact, but as the disease enters the subacute or chronic stages they show degenerative changes

Granular Casts—Granular casts occur in subacute and chronic nephritis The granulation, probably due in most cases to disintegration of epithelial cells, may be fine or coarse (Fig 75, E 1 2) or a mixture of the two With further degeneration the granules become changed into fat globules

Blood Casts (*Fig* 75, C 3)—Found in acute nephritis and other forms of renal congestion

Pus Casts (*Fig* 75, C 2)—Occur in renal suppuration

Fatty (*Fig* 75, D) *and Waxy* (*Fig* 75, F, 1) *Casts*—These represent corresponding degenerations of the kidney

Other Organized Deposits—

Prostatic Threads—Found in the urine in cases of chronic prostatitis, especially when the prostatitis is due to gonorrhœa The threads, often perceptible to the naked eye, are seen microscopically to consist of mucus, prostatic epithelium, and pus cells, the epithelial cells have the same appearance as those from the ureters

Spermatozoa—Sometimes present, and are easily recognized.

Fibrin—Fibrin appears in the form of characteristic wavy bands, which may be narrow and pale, or broad and, perhaps, reddish brown in colour, the edges are more refractive than the centre

Blood clots—These are seen as dark brown masses of disintegrated blood corpuscles

Mucus—Mucus occurs microscopically as corpuscles threads, and casts

Mucus corpuscles Occur as pale, finely granular, non nucleated corpuscles, and vary in size from that of a pus cell to that of a large epithelial cell

Mucus threads These are small in normal urine, but may be comparatively large when inflammation produces an excess of mucus, they are pale, and striated longitudinally

Mucus casts (also known as cylindroids) May be formed in any part of the urinary passages They are distinguished from hyaline casts by their undulating contour, tapering ends, longitudinal striation and, often, much greater length

Connective-tissue Shreds—In the urine connective tissue shreds may be derived from new growths, ulceration, suppuration, or other destructive process The shreds are composed of compact, irregular bundles of moderately refractive, wavy fibres, and the finding of these denotes a severe and deeply seated lesion

of the urinary tract The urinary diagnosis of new growth, by the recognition of its particles as neoplastic tissue, is a rare occurrence, and mostly made in cases of villous tumour of the bladder

MICRO ORGANISMS AND ANIMAL PARASITES

Micro-organisms —Urine in the bladder of a healthy person is probably free from infection, but when a specimen has been exposed to the air for a few hours it is found to be contaminated by the *Micrococcus ureæ* and various non-pathogenic fungi and infusoria *M ureæ*, by its conversion of urea into ammonium carbonate, is largely responsible for the ammoniacal decomposition of urine

The actinomyces fungus is not found in the urine except in the rare cases where actinomycosis affects the urinary tract

Pathogenic Bacteria —In pathological conditions, the chief pathogenic bacteria which may occur in the urinary passages are Gonococcus, tubercle bacillus, *B coli communis* and its variants, *B proteus*, *Sta pyogenes aureus* and *albus*, *Str pyogenes*, *Str fæcalis*, and the typhoid bacillus The *Leptospira* (or *Spirochæta*) *icterohæmorrhagiæ* is found in the urine in cases of spirochætosis icterohæmorrhagica (Weil s disease)

Any search for these organisms must be conducted with great care and thoroughness The urine should be obtained by catheterization, especially in the female When, in certain circumstances, the specimen cannot be got in this way the urinary meatus should be freed of infection and the urine passed directly into a wide necked sterile bottle, which is then stoppered, and the sample sent for examination without delay

Animal Parasites —The *Trichomonas vaginalis* is a protozoon flagellate which is not infrequently present in the urine of females, and in association with leucorrhœa In such cases the parasite is usually found in large numbers in the vagina Considerable controversy exists regarding its pathogenicity

The hooklets, membrane, and scolices of *echinococcal cysts* are on rare occasions discharged into the urinary passages

In tropical countries the embryos of *Filaria sanguinis hominis* and the ova of *Schistosoma hæmatobium* are commonly found in the urine of affected patients

Other parasites which may possibly find their way into the urine are the *Eustrongylus gigas*, the *Oxyuris vermicularis*, and the *Ascaris lumbricoides* and ova

For an account of the micro-organisms and parasites mentioned, and for the technique employed in their recognition, the reader is referred to appropriate text books

FOREIGN BODIES

A great variety of foreign bodies may be found from time to time in specimens of urine The following are some of those which may be readily recognized by the experienced observer Fibres of cotton, silk, linen, and wool, hairs, starch grains from dusting powders, scales from wings of moths, particles of feathers, oil globules, dust of wood and cork, vegetable fibres and cellulose, sputum, vomit, and fæcal matter The contamination of urine by fæces takes place, as a rule, outside the body, but may occur internally through a fistula On an average, fæcal matter contains vegetable fibres and cellulose, grains of starch and chlorophyll, fat globules, partly digested muscle fibres, connective tissue shreds, squamous epithelium from the anus, various putrefactive micro-organisms, mucus, and crystals such as ' triple ' phosphates and calcium oxalate

CHAPTER VII

THE HOUSE SURGEON IN THE RADIOLOGICAL DEPARTMENT (I)

By N M Matheson

The house surgeon spends a good deal of time in the radiological department, and he has to perform many important duties there

THE INJECTION OF LIPIODOL INTO SINUSES AND CHRONIC ABSCESS CAVITIES

The length and course of fistulous communications and the dimensions of abscess cavities can be well displayed by contrast media (*Fig* 76) Troublesome regurgitation of the solution at an external orifice is conveniently avoided by employing an olivary tipped cannula applied firmly to the surface opening For the deeper channels a tube should be passed well into the track before the injection commences, and to delineate deep narrow channels a watery preparation is often more suitable than a viscid oil For this purpose Lipiodol Emulsion No 2 is eminently satisfactory, as it is a bland perfectly miscible fluid which can be induced by gravity to permeate the depths of the finer ramifications of a cavity

Fig 76—Lipiodol injection into a sinus connected with a psoas abscess

To Outline a Chronic Empyema Cavity—The patient is placed on his sound side in such a position that his wound is the highest point, his empyema cavity being at a lower level Lipiodol is then introduced, without using the needle, direct into the wound from the syringe, and the patient moved so that all parts of the sinus are outlined It is often better to take the films in this position without the patient moving—antero posterior and lateral exposures being made

SIALOGRAPHY

Lipiodol injection affords a precise means of depicting the duct system of the parotid gland (*Fig* 77) The manipulations, though delicate, can be easily performed without anæsthesia The introduction of a lachrymal duct dilator is a useful preliminary measure A lachrymal duct syringe answers the purpose for introducing the opaque medium Having filled the syringe with warm lipiodol, the injection is made slowly The special

Fig 77—A sialogram in a case of parotid calculus The calculus lay behind the bulbous dilatation

syringe shown in Fig 78 renders the technique of the injection more precise About 1 c c suffices for the average sialogram, but the procedure should be stopped at the appearance of swelling over the gland or at the onset of pain The radiograph is taken first with the patient lying on his side with the head extended, and then in an antero-posterior direction

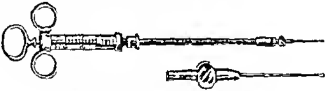


Fig 78 —Hamilton Bailey's sialography syringe

EXCRETORY UROGRAPHY

Contra-indications.—Excretory urography is contra-indicated in uræmic individuals Under these conditions it yields little data and may be attended by grave danger In any case of doubt a blood urea estimation is a desirable preliminary Particularly prone to reactions are patients with an idiosyncrasy to iodine Thyrotoxicosis and hepatic insufficiency are also contra-indications

With these exceptions excretory urography is perfectly safe if carried out as follows Before the examination the ingestion of fluids is limited and diuretic drugs are excluded The bladder should be empty at the time of the examination

Solutions and Dosage—*Uroselectan B* and perabrodil, or the newer pyelectan and uropac, are the preparations usually employed They are supplied in ampoules of 20 c c, which constitutes an adult dose For a child of from 3 to 12 years a dose of 10 c c of perabrodil is recommended In childhood the dose of uroselectan B is from 8 c c in the case of an infant to 12 c c or more for older children To the age of 10 years, 3 c c of pyelectan is sufficient and 1 c c of uropac may be employed for each year of age, with a minimum of 4 c c After the age of 15 years the adult dose may be used

Technique—The examination is carried out on a radiological couch fitted with a Potter-Bucky diaphragm A 20-c c Record syringe is filled from an ampoule of the sterile solution previously warmed to body temperature, and the contents are *slowly* injected into a suitable antecubital vein rendered prominent by the application of a tourniquet With the point of the needle well in the lumen of the vein, and proved so by a good regurgitation of blood, reactions are unlikely Immediately after the completion of the injection the puncture is sealed and compressed with a bandage

Exposures are usually taken by the radiographer at two, eight, and twenty minutes after the injection

Subcutaneous Pyelography—When the small calibre of the veins prohibits the intravenous route, a condition encountered particularly in childhood, subsidiary methods are available Perabrodil in isotonic solution is suitable for injection into the subcutaneous tissues It is diluted with double its volume of sterile distilled water, the dose of the diluted solution being from 40 to 100 c.c according to the patient This is injected in two equal parts into the thighs, and, employing suprapubic compression, photographs are taken at the end of half an hour, and thereafter at 15 minute intervals as required

Oral Pyelography—Also in those circumstances in which intravenous injection is impossible or inadvisable, satisfactory radiological information can be obtained by the oral route Hippuran, when administered by the mouth, is given dissolved in

75 c c of syrup, in doses of 12 g for adults and children over 13 years and 10 g for children under 13 years Continuous abdominal pressure is maintained, and plates are taken at 60, 90, 120, and 150 minutes following the ingestion of the drug

RETROGRADE PYELOGRAPHY

We will assume that ureteric catheters have been placed in position and the patient has been taken to the radiological department

Solutions.—Sodium iodide in a 12 5 per cent concentration casts a good shadow, is readily procurable, and can be conveniently sterilized by boiling Uroselectan B and abrodil in 20 per cent solutions are particularly free from irritation, and are now on the market in small ampoules especially prepared for retrograde use Uropac is also an excellent medium , the solution as supplied in the ampoules should be diluted with four times its volume of sterile distilled water

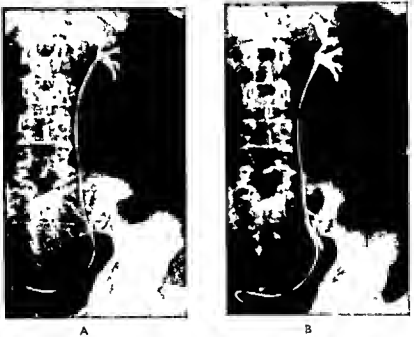


Fig 79 —A, Retrograde pyelogram showing pelvis incompletely filled B, More solution has been introduced and pelvis is now completely filled.

Amount to be injected.—The normal pelvis and calices require, on an average, 7 c c of solution to fill them In the case of a hydronephrosis considerably more fluid can be injected The criterion of the quantity to be injected is furnished by the conscious patient He should understand clearly that he is to report the moment he feels even slight discomfort in the loin

Technique.—A sterile towel is placed beneath the available portion of the ureteric catheter The hands are sterilized and a sterile 20-c c syringe is filled with the warm contrast medium A hypodermic needle of a suitable size to fit the end of the catheter is fitted to the syringe, or a special pyelographic point can be employed Slowly and steadily the contrast medium is injected At the

occurrence of the first discomfort the procedure is interrupted and a film exposed The film is developed and examined If the pelvis is incompletely filled a further injection is made In order to avoid accidents the following are useful rules —

1 *It is wiser to inject too little than too much solution If there is any doubt, it is better to restrict the amount to 3 c c, since, if evidence of incomplete filling (Fig 79) is forthcoming, the amount can always be increased later*

2 *On no account should an injection be made against resistance, and on no account should a painful response be neglected*

The Gravity Technique—Until some experience of pyelography is gained instillation of the fluid by gravity is recommended This method is also advisable in children, as well as for the exceptional case where pyelography in an adult has to be performed under general anæsthesia

A 20 c c syringe, with the piston removed, is fitted with thin rubber tubing filled with the pyelographic solution, and connected to a ureteric catheter already in position The syringe is raised or lowered according to the rate of flow, but never elevated more than eighteen inches above the situation of the kidney The meniscus is carefully observed, and when the flow stops, or at the onset of pain in the conscious patient, the syringe is lowered to the renal level and a film taken The contrast medium is then withdrawn by suction

CYSTOGRAPHY

The Catheter Method—The technique is simple and a 3 per cent solution of sodium iodide is usually sufficient to cast a good shadow, stronger concentrations are liable to irritate the mucosa and are generally unnecessary If, however, a greater density is demanded, a 5 per cent emulsion of silver iodide can be recommended

Having passed a catheter, the urine is evacuated and a plain film exposed to show possible calculi or encrustations of the bladder wall From a funnel and tube the warm solution is slowly introduced into the bladder until the point of discomfort, when the catheter is occluded and a penile clamp applied to prevent regurgitation along the urethra A film exposed at this stage, with the patient in a moderate Trendelenburg position, clearly shows the size and shape of the bladder and any irregularities thereof As, however, the vesical shadow might mask a pouch, a further picture is taken after evacuating the fluid through the catheter The emptying of a diverticulum may be gauged by placing the patient in the prone position for a few minutes and taking yet another film

The Excretory Method—Where urethral obstruction renders catheterization difficult, or when inflammation makes instrumentation undesirable, cystography by the descending route possesses evident advantages An exposure made about twenty minutes after the intravenous administration of 20 c c. of uroselectan B or perabrodil often gives an excellent shadow of the bladder

URETHROGRAPHY

Solutions—Lipiodol (5 per cent) in sterile olive oil gives a bland solution with good contrast capacity Neo-hydriol fluid casts an excellent shadow and, being less viscid than lipiodol, it readily permeates the small para urethral recesses

Contra-indications—For fear of embolism, recent intra urethral manipulations call for delay in performing the examination, and the presence of urethral hæmorrhage is an absolute contra indication

Position for Radiography—The correct position is important, as an uninterrupted view of the entire urethra is essential This may be obtained by placing the patient in the dorsal recumbent posture, inclined somewhat to

the left, with the left leg flexed at the hip and the right leg extended (*Fig* 80) A preliminary radiograph to include the whole pelvis is then taken

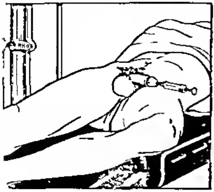


Fig 80 —Urethrography Position of patient on the X ray table.

Technique.—After evacuation of the bladder, the external meatus is scrupulously sterilized and the warm solution injected from a 20-c c Record syringe fitted with a conical rubber tip, the glans being compressed to prevent regurgitation of the medium Instillation proceeds steadily and gently with adequate protection of the surgeon's hands when the films are being taken At no time during the injection should undue pressure be exerted Having inserted about 15 c c, it is necessary—in order to secure a satisfactory picture of the posterior urethra—to continue the injection of the remaining 5 c.c. while the exposure is being made Spasm of the sphincters is obviated by asking the patient to attempt micturition towards the completion of the injection, the X ray being taken whilst the patient is endeavouring to urinate (*Fig* 81)

In the majority of cases the above method suffices To obtain a very complete urethrogram, a slightly more elaborate technique (J Kemble) may be employed, five radiographs are required —

1 A plain antero-posterior view of urethra, prostate and bladder regions

2 A-P view with 10 c c of radio-opaque fluid injected

3 A-P view with injection of 20 c c of fluid completed

4 Right oblique view at an angle of 45°

5 Left oblique view at an angle of 45°

Fig 81 —A normal urethrogram (*F Knutsson*)

THE GENITAL TRACT

Fig 82 —Radiograph of normal seminal vesicles following lipiodol injection. The outline of the vasa deferentia is clearly seen. (*From Sicard and Forestier's collection*)

Seminal Vesiculography—Uroselectan B (20 per cent) and lipiodol (40 per cent) are excellent contrast agents, they can be conveniently introduced by means of a small needle inserted into the lumen of the vas after its identification through a short incision made under local anæsthesia just below the external abdominal ring From 2 to

3 c c is an average dose to give a complete vesiculogram (Fig 82) To prevent the shadow of the pubic bones from obscuring that of the vesicles, the radiograph is taken with the patient raised slightly at the shoulders Overflow of the medium into the bladder, if masking the view, is removed by allowing the patient to micturate

A *peripheral injection can also be made, but as a rule the lumen is only outlined* as far as the globus minor

Hysterosalpingography.—First, pregnancy must be irrefutably excluded, by biological tests if necessary With the patient in the lithotomy position, the vagina is irrigated with flavine solution and the cervix exposed by the aid of a speculum The cervical lips are grasped with tenaculum forceps, the canal being then dilated if necessary A strong 20-c c syringe, attached by rubber tubing to an olivary-tipped uterine cannula, is filled by pouring warm undiluted lipiodol into the barrel and then replacing the piston The conical end of the cannula, inserted into the cervical canal, is maintained firmly in position, for, unless its junction with the cervix is tight, reflux of the oil is particularly prone to occur Under control of the fluorescent screen, the lipiodol is gently injected, the procedure being stopped at the onset of pain The amount inserted should at first be small, in the region of 3 c c, *larger quantities being later introduced* according to the radiological findings

Fig 83 —Hysterosalpingograph Right Fallopian tube patent, left occluded

Under normal conditions the uterine cavity is seen as a dense triangular opacity, from the upper angles of which the Fallopian tubes proceed laterally as linear shadows which widen at their ampullary extremities The radiological demonstration of a few drops of oil within the abdominal cavity is conclusive evidence that the tubal pathway is patent (*Fig* 83)

THE GASTRO-INTESTINAL TRACT

Preparation for Opaque Meals.—No aperient should be taken the night before the examination, and no food or drink whatever be allowed on the morning of the examination The meal is best given at about 9 or 9 30 a m, and the subsequent taking of food must necessarily depend on the emptying time of the stomach It is important, in cases where an examination of the whole gastro-intestinal tract is required, that the stomach be quite empty of the opaque meal before any other food is taken, otherwise this will mix with the opaque residue and complicate the findings

Preparation for Opaque Enemas.—A good aperient should be given the night before the examination, followed by a soap-and-water enema on the morning of the examination It is extremely important that all fæcal material should be cleared from the colon before the opaque enema is given

Radiography as a Diagnostic Aid in Acute Abdominal Conditions.—Apart from excluding calculi, direct radiography of the abdomen is sometimes employed in urgent surgery By using a modern portable apparatus, valuable information is obtained with little discomfort to a patient in *Fowler's position* In the flat plate, the characteristic crescent of translucency beneath the dome of

the diaphragm (*Fig* 84) establishes the presence of pneumoperitoneum in the anomalous case of perforated peptic ulcer This radiological demonstration of pneumoperitoneum can be an invaluable help when rupture of the intestine is suspected, particularly in air raid casualties afflicted with multiple injuries On

Fig 84 —Pneumoperitoneum. Crescent of gas below the right dome of the diaphragm. Direct film taken with portable apparatus in a case of perforated peptic ulcer

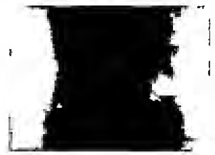


Fig 85 —Multiple horizontal fluid levels. Plain film of the abdomen taken in a case of acute obstruction of the small intestine following a previous appendicectomy

the left side, however, be careful not to mistake the shadow of gas in the gastric fundus for that of air in the peritoneal cavity Distended coils of intestine with horizontal fluid levels confirm an obscure intestinal obstruction (*Fig* 85)

CHOLECYSTOGRAPHY

Opaque Media —Of the preparations available, opacol and shadocol are not unpleasant to take and are commonly employed, full details of the respective doses being supplied by the manufacturers

Preparation and Radiography —An aperient, preferably one to which the patient is already accustomed, should be given thirty six hours beforehand —and to obviate gas formation it is advisable to have the patient up and about as much as possible prior to the test Pitressin injected intramuscularly in doses of 1 c c (two and a half hours and half an hour before taking the films) is of considerable value in dispelling confusing intestinal shadows In all cases of a suspected lesion of the gall bladder, a preliminary radiograph is indispensable

On the day preceding the examination the patient is allowed his usual diet up to and including tea At 6 p m he takes a light meal (free from fats), and one hour later swallows the dye well stirred in half a glass of water During the subsequent hour water is taken in sips, but thereafter no food is permitted until the examination is completed on the next day, the first radiograph being made at the fifteenth hour following the ingestion of the dye Should the initial film show only a faint shadow, a further plate is exposed one hour later When a good outline of the gall bladder had been obtained a fatty meal consisting of cream, butter, and eggs is given and radiographs are again taken, these show the emptying capacity of the gall bladder, and often detect stones which may be only visible in the partially evacuated viscus

INTENSIVE ORAL CHOLECYSTOGRAPHY

P Kerley's method of intensive or double dose cholecystography usually takes about an hour for the complete examination, the technique is simple and, with the aid of a compressor, sufficiently good concentration is obtained

Immediately after lunch on the day prior to the examination, the patient takes 2 g of the dye At 7 p m he has a fat-free dinner and takes 4 g of the dye an hour after this, during the evening a bottle of alkaline water is drunk The examination takes place between 10 and 11 a m on the next day If the first pictures in the prone position show a good shadow, another picture is taken in the erect posture Further plates are taken 5, 10, and 30 minutes after a fatty meal

POST-OPERATIVE CHOLANGIOGRAPHY

The injection of an opaque substance to visualize the biliary tract is now a standard post operative procedure in cases where the common bile duct has been drained With the aid of a portable apparatus it can be carried out with the patient in bed.

The ramifications of a biliary fistula are well shown and, what is most desirable, the radiological picture supplies positive proof as to whether the common duct is patent or not (*see Fig* 220, page 191) Sometimes calculi are discovered in the ducts when least suspected, and characteristic deformities of pancreatic compression may be forthcoming

The Opaque Medium—Pure lipiodol is too viscid and its dense shadow sometimes masks a calculus *Lipiodol and olive oil* (equal parts) is most satisfactory *Hippuran* is also to be recommended

Preliminary Preparations and Precautions—Cholangiography is always to be performed with the patient fasting To demonstrate whether or not there exist any calcifications in the upper abdomen, a direct film is a necessary preliminary The injection must be slow and should cease if the patient experiences any pain

Technique.—A 20-c c glass syringe is eminently suitable First ascertain that its nozzle will accurately fit the tube draining the biliary tract Discrepancies in size are readily overcome by rubber tubing and a glass connexion Remember to hold these laterally during the examination so that their shadows are not superimposed upon those of the injected ducts

A small pack of gauze around the drainage tube is a useful safeguard to protect the abdominal wall from any opaque solution which might regurgitate around the tube during the injection and so obscure the films

Place the opened ampoule of the opaque substance in a bowl of warm water Fill the syringe with the warmed contrast medium and take care to exclude all air bubbles, for these give ' false shadows ' which closely simulate calculi on the radiological film Commence the injection slowly and proceed slowly, stopping if the patient indicates any pain After 10 c c have been introduced, remove the protective gauze, and take the first film, while the patient holds his breath Usually this amount is sufficient, but if not, a further 5 c c is injected and a second plate taken Finally aspirate the fluid introduced

CHAPTER VIII

THE HOUSE SURGEON IN THE RADIOLOGICAL DEPARTMENT (II)

By F DUDLEY HART

BRONCHOGRAPHY

By bronchography is meant the outlining of the bronchial tree by introduction of a suitable non toxic radio-opaque substance Such a substance is iodine in poppy-seed oil—lipiodol (Lafay), neo-hydriol (May & Baker), etc Iodine in a combination of this nature is inert and said not to cause iodism unless swallowed

The lipiodol may be introduced into the respiratory tract in a variety of ways (*a*) By injecting through the cricothyroid membrane, (*b*) By injecting directly into the bronchi via a bronchoscope, (*c*) By injecting over the back of the tongue, (*d*) Through the nose, and so on For general purposes the first—given a reasonable degree of skill—is best, as it is usually the quickest, gives the best pictures, and is somewhat easier to perform than the others

Indications—To reveal any abnormality in size or shape of any of the larger bronchi, and to localize such abnormalities, only one side of the chest should be filled at a time This should be done completely at the one sitting, antero-posterior and lateral films then being taken Lateral views, so essential to localization of a lesion, are of no use when both sides of the chest have been filled, for the picture is then a confused blur Lateral views should be taken as a routine in addition to antero-posterior views In seven to ten days the lung will have cleared sufficiently for the other side to be done

Contra-indications—A weak, feeble, or febrile patient should not be subjected to bronchography, nor patients with marked cardiac decompensation Cocaine sensitive patients should not receive this drug In a case of pulmonary tuberculosis it complicates the radiograph and may do harm to the patient

Precautions—Sensitivity to the substances used should be tested for some days beforehand Three minims of 5 per cent cocaine hydrochloride are injected subcutaneously, and the patient watched for the next half hour A transitory feeling of discomfort may be disregarded, but anything more considered as a danger sign Reactions are faintness, flushings, dilated pupils, nausea, sickness, or acute distress

Reactions to iodine only occur when lipiodol is swallowed, and this should not happen The reactions occur some days later—skin rashes and puffiness of the face Potassium iodide, 20 to 30 gr, is used as a test for iodine intolerance Many patients during and after bronchography cough the oil into the mouth and then swallow it They should therefore be warned against this and, after the films have been seen and passed as wet plates, encouraged to expectorate as much as possible If lipiodol on screening is seen to have entered the stomach of an iodine sensitive patient, it should be washed out immediately afterwards

Armamentarium—This is illustrated in *Fig* 86

Technique —

1 Prop the patient up on the couch with the shoulders raised on several pillows and the laryngeal promontory pointing upwards, and inject 10 minims or so of novocain over the cricothyroid membrane, felt as a depression just below the promontory of the larynx

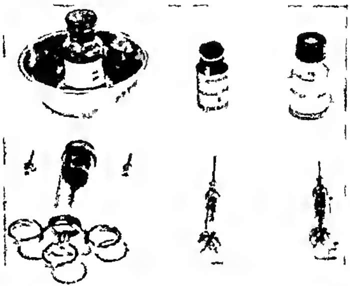


Fig 86—Armamentarium for bronchography

Fig 87—Position of patient for injection to fill the basal bronchi.

2 With a longer, thicker needle inject 4 minims of 5 per cent cocaine hydrochloride into the trachea through the area anæsthetized Withdraw the plunger and suck in air first, to be certain the point of the needle is in the trachea and not in the surrounding tissues Inject rapidly and withdraw the needle at once as the patient immediately coughs and may break the needle in his neck.

3 Pour the lipiodol or neo-hydriol (20 c c warmed to blood heat) into the special 25-c c syringe, attach the special needle, and introduce into the trachea Withdraw the plunger as before, and when in the trachea raise the patient's opposite shoulder to allow the lipiodol to run only into the side required Introduce 7 c c and wait one minute This fills the basal bronchi (*Fig* 87)

Fig 88 —The position for filling the middle lobe or the corresponding bronchus on the opposite side

4 With the needle and syringe in situ, make the patient sit and lean with the opposite shoulder forwards to look down towards the floor on the affected side Inject 6 c c and wait two minutes This fills the middle lobe on the right side or the corresponding bronchus on the left (*Fig* 88)

5 Lay the patient on the affected side, inject as rapidly as possible the remaining 7 c.c , and *rapidly* elevate the feet, so that the patient is lying with his head 12 inches or more below his heels, half on his side, half on his face Remove the needle and leave him thus for two to three minutes This fills the apical bronchi (*Fig* 89) For this stage, if it is impracticable to elevate the couch at the foot, a stretcher may be used on which the patient lies from the beginning

6 Take the films from a distance of 6 ft , antero-posterior and lateral, or any other view desired Screen if desired Warn the patient not to cough or swallow from the time of the injection of cocaine to

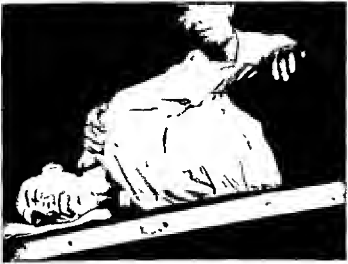


Fig 89 —Position for filling the apical bronchi.

the time the radiograph has been seen and passed The films are taken in full inspiration, and at fairly great intensity (*Fig* 90) Only by using these postural methods can one be sure of filling all the zones of a lung If the

lesion is thought to be in the apex the picture should be taken with the patient still in the position shown in Fig 89

A B

Fig 90—A Right bronchogram normal filling B Right bronchogram lateral view normal filling

In cases of bronchiectasis when postural drainage is being practised, screening two to four days later may reveal iodized oil in cavities undrained This calls for improvement in the technique of posturing for the affected area

CHAPTER IX

HOLLOW-NEEDLE TECHNIQUE IN INJECTION THERAPY

By Hamilton Bailey and Sister Pauline

There is little doubt that reputations have been made—and lost—by the hollow needle In this instance there is no excuse for inadequate apparatus on the score of expense As in every walk of life, skilled technicians not only provide themselves with the necessary equipment, but are vigilant in maintaining it in perfect order

Desirable Accessories —

An Arkansas Stone —Hollow needles must be sharp If they are to be used repeatedly a cork and an Arkansas stone for sharpening them should be at hand (*Fig* 91)

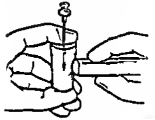


Fig 91 —By thrusting the needle through a cork in the manner shown it can be sharpened and the length of its bevel altered to suit circumstances

Fig 92 —A useful file for opening ampoules (½ *scale*)

Fig 93 —An ampoule cannula.

A File —The files provided with ampoules are flimsy, and quite unsuited to making the necessary deep score on the neck of a thick glass ampoule The file shown in *Fig* 92 can be purchased at any bargain stores for 3d It will save time and many a cut finger from broken glass

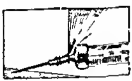


Fig 94

An Ampoule Cannula —The familiar picture of a struggle to fill the syringe by way of a hollow needle vanishes if one is provided with a special cannula (*Fig* 93)

Emery Paper —A small piece of emery paper used from time to time on the nozzle of the syringe minimizes the frequent happening shown in *Fig* 94

Small Duck-bill Forceps —Unless one is provided with a pair of forceps of special design (*Fig* 95), it is difficult to remove syringes from the sterilizer

Fig 95 —Forceps for removing syringes from the sterilizer

An Adaptor—Syringes of foreign make often do not fit the standard needles issued in this country. An adaptor (*Fig* 96) is a handy little fitting to possess.

A glass 'window' attachment (*Fig* 97) is useful when intravenous injections are to be made.

Fig 96—An adaptor

Fig 97—Window fitting for observing drawn blood

Ordering Needles.—The bore of a hollow needle is described in terms of standard wire gauge (S W G). *A hypodermic needle with an S W G of 27 is a fine one*, a needle with a long bevel should be chosen.

Hollow needles are made in steel, rustless steel, and platino-iridium. The rustless steel variety is best for general purposes. Hypodermic needles, beautifully put up in metal boxes, are so inexpensive that some practitioners, rather than trouble to sharpen them, use hypodermic needles but once, in which case the rustless variety is unnecessary. A platino-iridium needle, although comparatively expensive, has the advantage that it can be sterilized by holding it in a flame *until it is red-hot*.

Suitable needles for intradermic, intramuscular, and intravenous use will be described in their appropriate sections.

Sterilization of Syringes and Needles.—So-called sterilization by solutions of carbolic acid and other antiseptics, along with spirit, *is inadequate*. It is true that many are satisfied with such measures, for it is only very occasionally that doleful consequences of imperfect sterilization come to light. One of us has seen a member of the medical profession with an angry cellulitis of the thigh following a self-administered hypodermic injection. Let those who consider that exhortations for unimpeachable sterilization of hollow-needle equipment belong to the class-room rather than to the domain of everyday practice reflect that in 1939 C H Harney was able to collect 86 cases of gas gangrene following subcutaneous and intramuscular injections, 76 of which terminated fatally. J. W. Bigger et al exhort the practitioner to have two sets of syringes and needles—one for the injection of therapeutic products into healthy tissues, and the other *reserved solely for the withdrawal of pathological fluids*.

The only really safe method of sterilizing syringes and needles is by boiling them, preferably in 1 per cent phenol. The syringe is taken apart and, together with the needle, wrapped in gauze. The gauze packet is placed in cold water, *brought to the boil, and boiled for at least fifteen minutes*. *Providing the syringe* and needle have been boiled, there is no objection to storing them in spirit. The following is a good solution for the purpose:

℞	Lysol	♏ xx
	Ether	℥ ij
	Industrial spirit	ad O j

Metal does not rust or corrode in this solution.

Sir Almroth Wright's Method—We have no experience of this method of sterilization, but the fact that it has received the approbation of a great bacteriologist and that it is used as a routine at the Red Cross Clinic for rheumatism, where thousands of injections of vaccine are given, seems sufficient authority for

its inclusion A porcelain crucible containing olive oil is placed on a gas ring At *140 C olive oil* bubbles *When it is bubbling* the *syringe minus the needle*, is filled two or three times with the oil The needle is then fitted to the syringe and some of the same oil is sucked through it two or three times The oil is removed by drawing up ether The method has an advantage—a sharp needle remains sharp

Making up a Dose of Hypodermic Medication from a Hypodermic Tablet—A teaspoon and some boiling water are the requisites The spoon is held in the boiling water for a moment The teaspoon containing some of the water is laid down A little more than half a syringeful of the water is sucked up from the spoon (*Fig* 98 A) The spoon is emptied and the hypodermic tablet cast into the spoon from the container (*Fig* 98, B) The water in the syringe is squirted into the spoon containing the tablet (*Fig* 98 C) When it has dissolved the solution is drawn up into the syringe (*Fig* 98 D) The needle is now affixed to the syringe for the first time in the procedure

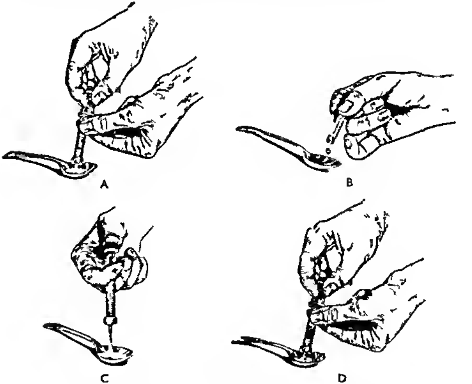


Fig 98—Making up a dose of hypodermic medication from a tablet.

Minimizing Pain in Hypodermic Injections—The needle must be fine, *sharp and have a long bevel* Spirit causes pain, if the syringe has been stored in spirit it should be rinsed in sterile water or ether drawn up into the syringe The last trace of ether is expelled by aspirating the air Some practitioners find that to sterilize the skin with methylated ether instead of spirit is to impart slight local anæsthesia

Hair follicles must be avoided A hairless area is chosen for the injection Far better than pinching up the skin is to stretch it (*Fig* 99) The needle is thrust into the subcutis The content of the syringe is delivered and the needle withdrawn Pressure is applied with a swab and the area massaged for a moment

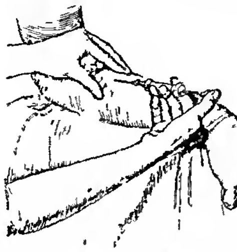


Fig 99—*When making a hypodermic injection stretching the skin is far better than pinching it up*

* INTRADERMAL INJECTIONS

Intradermal injections are used for the Schick test and also for those of Dick and Mantoux The technique is important, since, if imperfectly performed, the results of these tests are fallacious A very short needle with a short bevel (*Fig* 100) is employed With the left hand encircling the forearm, the index finger and thumb stretch the skin tightly between them The needle is inserted into the dermis with the bevel facing the operator, the penetration being almost parallel with the surface, and in the line of the stretch The injection must be performed slowly and be made into the skin itself If the procedure is carried out correctly a white wheal (nettle-sting) is raised above the skin level During the injection some resistance must be felt, if none is met and the injection is easy, then the skin has been wholly pierced, and the test is invalid

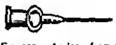


Fig 100—An intradermic needle. (*Actual size*)

INTRAMUSCULAR INJECTIONS

A needle for intramuscular injection should have a long bevel, be of S W G 22, and 2 in long (*Fig* 101) When making an intramuscular injection the skin should be stretched as for a hypodermic injection, and the needle plunged in almost at right angles to the surface (*Fig* 102)

Fig 101—Intramuscular needle (*Actual size*)

Especially if viscid fluids are to be injected, the lockhead type of syringe is advisable

* Written by A E Hodgson

Necessary as it is at all times to be provided with sound needles, to employ an old and corroded needle for an intramuscular injection is frankly negligent, a fracture between the hub and the shaft is the usual accident

When injecting a fluid which is liable to cause irritation in the subcutaneous tissues, a good method is to have a bubble of air in the syringe After injecting the solution into the muscle, the bubble of air is injected, which ensures that the needle is empty while it is being withdrawn The following are the preferable sites for the injection —

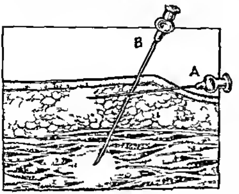


Fig 102 —Subcutaneous and intramuscular injections showing the angles of the needle

The Deltoid—This is an admirable site when the amount of fluid to be injected is comparatively small

The Lateral Aspect of the Thigh —The patient should brace the limb and bear his weight on the side which is to receive the injection

The Gluteal Region—The prone position is best Relaxation of the musculature of the buttock is obtained by turning the toes inwards For purposes of injection the buttock is visualized as being divided by two intersecting lines (*Fig* 103) The upper and outer quadrant is chosen because nerve-trunks and blood vessels will not be encountered here The needle can be inserted more or less at right angles into this 'safe area' In this quadrant the only essential consideration is to avoid striking bone, and the angle which the needle takes is set accordingly

The Pectoralis Major—With the patient's arm raised to a right angle the pectoralis major is grasped between the finger and thumb The needle is thrust into the muscle through skin overlying the anterior fold of the axilla That the centre of the muscle is penetrated is easily determined by the grasping finger and thumb Up to 20 c c is well tolerated in this muscle, and absorption is rapid Even when irritating substances are injected there is less pain and tenderness than when the injection is made in the buttock (C Walker)

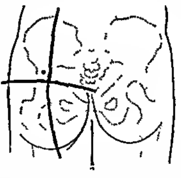


Fig 103 —The upper and outer quadrant of the buttock is chosen for an intramuscular injection, the better to avoid the great sciatic nerve and other important structures.

INTRAVENOUS INJECTIONS


Fig 104 —A syringe with an eccentric nozzle simplifies intravenous injection.

The needle should have a short bevel, but otherwise there is no need to vary it from the ordinary large hypodermic variety To employ a syringe with an eccentric nozzle (*Fig* 104) is an advantage.

Intravenous injections play a large part in modern practice Excretory pyelography, intravenous anæsthesia, intravenous infusion, blood transfusion, and the treatment

of syphilis and varicose veins are examples where it is most desirable to be an adept in inserting a hollow needle into a vein

To become efficient at venipuncture requires practice Bungling is only too frequent, let alone the pain, waste of time, and annoyance caused thereby, the crop of medico-legal cases which have sprung up around intravenous medication should stimulate the house surgeon to lose no time in mastering the technique

Especially when the solution to be injected is known to be irritating if extravasated outside the vein wall and/or the veins are likely to be 'difficult', Edwards's vein seeker, which will be described presently, is valuable, even to an expert A vein in *front of the elbow is usually chosen A very* important point is to have the elbow-joint fully extended—even hyperextended—and a folded towel behind the elbow achieves this purpose The self-releasing vein tourniquet shown in *Fig* 105 is ideal for general use It is a mistake to choose the most prominent vein, one easily palpable but well obscured and supported by subcutaneous fat will be found less mobile and thus more readily entered The large prominent veins of the aged are notoriously difficult to enter

Fig 105—A self releasing vein tourniquet

The skin is prepared by using a fat solvent (ether), followed by spirit The needle must be sharp, *blunt needles frequently tear the vein As a rule* the skin is pierced separately The vein is immobilized by support from the tip of the index finger, and by stretching the overlying skin with the thumb (*Fig* 106) The vein is entered in the side opposite to the supporting index finger Once the vein wall has been pierced the bevel of the needle is rotated so that it looks downward (*Fig* 107) Blood should enter the needle spontaneously if the venous pressure is within normal limits *It is for this* purpose that the window fitting (*see Fig* 97) is useful Before the injection is made the tourniquet must be released

Fig 106—Method of stretching the skin and steadying the vein while performing venipuncture

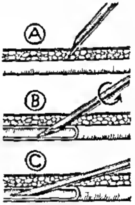


Fig 107—*Stages of venipuncture*

Edwards's Vein Seeker (*Fig* 108) is most useful, especially when veins are collapsed or otherwise difficult to locate The vein seeker is filled with sodium citrate solution It is 4 in long, and thus allows the butt end of the needle to be held between the thumb and forefinger while the teat is compressed

by the 4th and 5th digits against the hypothenar eminence The teat, now compressed, is empty, but the rest of the instrument is still filled with citrate solution The point of the needle is inserted under the skin where the vein

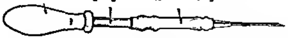


Fig 108—Edwards's vein seeker

is suspected and the pressure on the teat released The teat remains collapsed until a vein is entered, when the negative pressure within the teat draws blood into the instrument When blood appears in the glass tube the whole instrument is fixed in position by two strips of adhesive plaster By sterilizing the

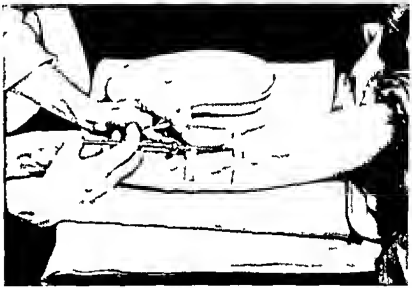


Fig 109—Edwards's vein seeker in use.

rubber tubing between the needle and the sight glass with spirit, the necessary injection can be made into the rubber tubing (*Fig* 109) and from thence into the venous system The great advantage of this apparatus is that it allows *repeated intravenous injections to be made without repeated puncture*

CHAPTER X

THE ADMINISTRATION OF SERA

By A E HODGSON

Apparatus —All parts of the apparatus should be standardized in such a way that hollow needles, syringes, adaptors, and lumbar puncture needles fit one into another accurately The glass and metal (Record) type of syringes are best, they can be obtained in all sizes, the 20 c c size with an eccentric nozzle being the most useful for serotherapy After an injection of serum is completed, the syringe should be taken to pieces at once, if this is not done, the piston is liable to become glued in the barrel by coagulated serum

Serum —The vials of serum are placed in water at blood heat (100 4° F) When it is warm the injection of serum intramuscularly is less painful, and its absorption is more rapid *In order to avoid shock, it is essential that serum, given intrathecally or intravenously, should be at blood heat*

Sera are issued in long necked glass vials or rubber capped bottles of various sizes In the former, the neck of the vial is tapped, so that no serum remains there, and, grasping the neck in a sterile swab, it is snapped off The serum is then drawn into the syringe, avoiding bubbles Rubber capped bottles allow a part of the serum to be withdrawn The cap must be sterilized with ether or spirit To ease withdrawal, first draw out the syringe piston to the level of serum to be aspirated Then plunge the needle through the cap, and force the air into the bottle, this permits the abstraction of the correct volume of the contents of the bottle without difficulty Alternatively, pierce the cap with a hollow needle, leaving it *in situ* to admit air, whilst the serum is being drawn off *via* another hollow needle

METHOD OF ADMINISTRATION

Preliminary Precautions —*Inquire into the patient s history In known* allergic cases, and patients subject to spasmodic asthma or hay fever, or those who have received an injection of serum at some previous time, a state of hypersensitivity may be present In such instances, an attempt to desensitize must be made by giving serum in a special manner, thus at intervals of half an hour, inject subcutaneously 0·5 c c, 1 0 c c, 1 5 c c and 2 0 c c, and *follow* intramuscularly *in a further half* hour with the therapeutic dose

Modern inoculation measures to produce active immunization against diphtheria by means of T A F, A P T, etc, do not hypersensitize the subject and therefore in no way contra indicate the injection of serum

ROUTES

The Subcutaneous *Route* has been discontinued as serum thus injected *is not* absorbed effectively

The Intramuscular Route is the most usual, and serum given by it is absorbed almost entirely within a few hours The buttock is the best site, and here 50 c c or more can be injected For small amounts, 2 to 5 c c, the sites indicated on p 72 are efficient

The Intrathecal Route has fallen into some disfavour during recent years, greater reliance being placed, in tetanus particularly, in large doses of serum administered intravenously. The intrathecal injection must be made very slowly, and in no circumstances should the amount of serum injected be more than two-thirds of the volume of the cerebrospinal fluid withdrawn. After the injection a pillow should be placed beneath the pelvis and the foot of the bed blocked for an hour.

The Intravenous Route allows absorption to commence in a period of minutes, hence this is the route of choice in urgent conditions.

Technique of Injecting Serum Intravenously.—The injection may be made in two ways:—

1. *With a Syringe.* The average 20-c.c. syringe holds, in fact, about 23 c.c., and this volume, in the case of diphtheria serum of the modern highly concentrated type, may represent 160 000 units or more. The serum is drawn up into the syringe, almost, but not quite, filling it. Bubbles are expelled. The nurse holds the arm steady, her left hand compressing the upper arm and her right holding the patient's hand. If one syringe will not hold the full amount of serum to be injected, a second, already charged, should be at hand. Without withdrawing the needle, the emptied syringe is detached, and the tip of the index finger is held over the butt of the needle to prevent escape of blood until the second syringe can be attached and injection completed.

Fig. 110.—Apparatus for administering serum intravenously by gravity.

2. *By Gravity.* A funnel, or the barrel of a large syringe, and rubber tube apparatus is used. The tube is about three and a half feet long, with the funnel at one end, and an adaptor to which the serum needle (size 18) is fitted, at the other; about nine inches from the needle, a glass tube is interposed for a window (*Fig.* 110). Administration by gravitation is employed when large amounts of serum, impracticable with a syringe, are necessary. Gravitation has the advantage that the process can be started with saline, and the serum can be added gradually, until pure serum is flowing. The drip method can be employed (for its disadvantages, *see below*). Gravitational methods are not suitable for children.

THE HAZARDS OF SERUM INJECTIONS, WITH SPECIAL REFERENCE TO THE INTRAVENOUS ROUTE

Reactions may be manifested either early or late; they vary greatly in severity.

EARLY REACTIONS

Anaphylaxis.—Sudden, fatal anaphylactic seizure has been recorded. The patient says he cannot breathe, there is extreme pallor, and spasm of the respiratory muscles. Although I have worked in large infectious diseases hospitals for nearly thirty five years, I have never seen a case of this kind. Nevertheless, during and after the administration of any serum we must be prepared to recognize and treat promptly anaphylactic phenomena. *Sudden pallor, dyspnœa, and muscular spasm of the platysma are dangerous signs.* *Discontinue the serum* and give hypodermically 5 to 8 min. of adrenaline at once. A syringe duly charged with this dose of adrenaline, or ephedrine if preferred, should always be at hand when injecting serum. My practice is to give adrenaline 5 min. at the time of the injection of the serum as a routine. When the injection is completed

a drink of hot tea or brandy is given, and hot-water bottles are placed near the patient

Rigors.—More or less severe rigors usually follow within half an hour of an intravenous injection of serum In my experience rigors are more frequent and severe when gravitation methods are employed, and they reach their zenith of frequency when the drip method has been used The probability of the rigors occurring should be explained to the patient Rigors are not to be regarded with alarm, and they pass off after a varying period

Œdema, particularly of the face, is an occasional untoward symptom, and is usually accompanied by a feeble pulse Adrenaline and coramine should be administered forthwith and warmth applied to the body Rapid recovery is usual

General Malaise.—Under this heading various symptoms are included A sense of heat, palpitation, and beating in the head are all fairly common, and the patient should be warned beforehand that such symptoms are to be expected

Severe Local Reaction.—Sometimes within half an hour or less at the site of the injection an angry, reddened area appears

LATE REACTIONS

Serum Rash.—This usually appears eight to twelve days after the first injection, and the first sign of it is seen at the site of injection—an important diagnostic point Although it often becomes generalized, it disappears last at the injection site It commonly assumes an urticarial form, and less often is erythematous The urticaria is irritating, it may be localized or widespread It may fade in an hour or two, or persist for two or three days, ebbing and flowing in intensity The itching is intense, the temperature usually raised, and there is accompanying general malaise

'Serum Pains'.—These are often coincident with the rash There is pain in muscles, joints, and lymphatic glands Serum pains may light up rheumatic diathesis and its attendant dangers into activity

'Serum Disease'.—Serum disease is a general term which includes the above phenomena, which are often associated with anorexia, nausea, furred tongue, and sore throat There may be oliguria This serum disease often renders the patient seriously ill

Treatment—Little can be done to prevent serum disease with certainty Calcium gluconate, chloride, or other preparations given twice daily from the time of the injection of the serum for a fortnight have a prophylactic effect and should be prescribed in cases of known or anticipated severe reactors

CHAPTER XI

SALINE INFUSIONS

By Hamilton Bailey

RECTAL SALINE INFUSION

Rectal saline infusion has the advantage of simplicity, it requires neither special apparatus nor asepsis A solution containing a drachm of salt to a pint of water, at a temperature of 115 F, is allowed to gravitate into the rectum through a funnel and tube connected to a catheter The patient's hips are elevated, and the funnel is held at a height of 2 ft The usual amount of infusion is half a pint every four hours

The celebrated John B Murphy, of Chicago, introduced continuous rectal saline infusion (*proctoclysis*), which was a distinct advance, especially in cases of peritonitis Slow, continuous delivery of the saline aided its absorption, and caused less disturbance to a patient in a critical condition Some believe that the administration of saline by the rectal route satisfies almost every requirement (*Fig* 111)

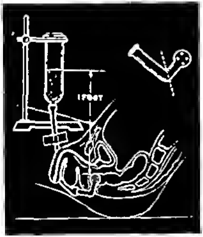


Fig 111—Diagram embodying the essential principles of proctoclysis as laid down by Murphy *Inset* Murphy's glass cannula the part to the right of the dotted line lies in the rectum

I have heard it said that if a mariner with "water, water everywhere, nor any drop to drink" were equipped with a funnel and tube, he could absorb sufficient sea water via the rectal mucosa to avert death for days or even weeks Whether or not this is true a close observer soon realizes that rectal saline, even when given by an experienced and painstaking nurse, *is frequently returned, particularly in cases* where it is most needed I am compelled to agree with Willard Bartlett, of St Louis, that whoever wishes to adopt saline by the rectal route exclusively should first administer it a few times in person, and watch the results

Summarizing, rectal saline is simple and safe, but slow and not satisfyingly certain

INTRAVENOUS INFUSION

SINGLE MASSIVE DOSE

Intravenous infusion given in a massive single dose (a pint or more) has many times saved life True, saline and other isotonic solutions are but poor substitutes for whole blood, but occasions arise when urgency forbids the delay inseparable from blood transfusion

When a patient is collapsed his veins will be in a like condition, and it is necessary to insert a cannula into the vessel

Technique—Before commencing to expose the vein, the funnel and tube should be filled with the solution To ensure the absence of air in the tube and

nozzle, some fluid is permitted to escape As soon as air-locks and bubbles are eliminated, the tube is clipped (*Fig* 112)

A rubber catheter is placed around the arm If the veins in front of the elbow are not visible, the venous blood is milked upwards from the wrist A folded towel is placed beneath the elbow to hyperextend the joint If the patient is conscious, a little local anæsthetic is injected into the sterilized skin over the vein A short transverse incision is made through the skin, and the beak of a small hæmostat introduced into the wound and its jaws opened widely (*Fig* 113) If this manœuvre is carried out once or twice the vein will be cleared from the subcutaneous tissues better than by painstaking dissection, and there is no fear of tearing even a delicate vein The entire circumference of the veins must be freed over a distance of about 1 cm before passing two catgut ligatures beneath it The distal one is tied Traction on the proximal ligature will prevent loss of blood while the vein is opened The vein wall is picked up in dissecting forceps and with fine-pointed scissors a triangular flap is raised The apex of the flap is grasped in a hæmostat or by dissecting forceps (*Fig* 114) It is a good practice to put a fine hæmostat on each lateral edge, as shown

Fig 112—Funnel and tube in readiness for an intravenous infusion

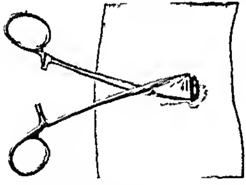


Fig 113—A rapid and efficient method of displaying a subcutaneous vein through a small transverse skin incision

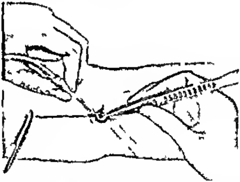


Fig 114—A vein exposed at the fold of the elbow ready for the insertion of the cannula

Fig 115—A good method of inserting a cannula into a small vein (*After J L Keeley*)

in *Fig* 115 With this technique a cannula slightly larger than the vein can be inserted When the nozzle (through which saline is now running) is within the lumen the proximal ligature encircling the vein and the nozzle within it, is tied in a half knot After the administration, as the last ounce of fluid is gravitating into the vein, the cannula is withdrawn, and the ligature surrounding the vein is quickly tied Having cut the ligatures two skin sutures are required to complete the operation

CONTINUOUS INTRAVENOUS INFUSION (VENOCLYSIS)

Useful as is the massive dose of intravenous saline, the indications for its use are limited It must be borne in mind that unless there has been a corresponding loss it is manifestly unphysiological to put into the circulation a pint of fluid more or less suddenly In moderate, as opposed to severe, shock, dehydration from vomiting, oliguria, and many forms of toxæmia, a slow continuous flow of saline intravenously approaches the ideal, for we know exactly how much fluid the patient is receiving The fluid can be given over a period of days, and the rate of flow and the amount of fluid can be regulated with mathematical precision

Preparation of the Solution —Obviously a solution which is introduced directly into the circulation must be absolutely sterile, but this is not enough—it must also be free from dead bacteria and other extraneous matter, such as fur from the sterilizer *Boiled tap-water does not fulfil these requirements, and if it is used reactions are bound to occur* Triply distilled water not more than a week old must be employed in all cases

It is, of course, equally important to have the sodium chloride sterile and pure. *Tablets sold in tubes for the preparation of normal saline are not prepared with a view to intravenous therapy* Sterile ampoules for making the solution are obtainable

Saline or Saline and Glucose?—Normal saline solution alone meets most requirements *When glucose is employed we are introducing a substance into the circulation which requires catabolism*, and if glucose is to be used there should be adequate reasons for its introduction, the patient must be in need of glucose, as one who has been starved, and only sufficient glucose for his immediate needs must be introduced by the intravenous route As regards insulin, if there is no reason to think that there is a deficiency of this hormone, there is no reason to give more

Apparatus —Special needles and cannulæ for intravenous infusion are available The cannula shown in *Fig* 116 will be found to be satisfactory Every portion of the apparatus (*see Fig* 121)* must be freshly boiled and washed through with sterile water or saline before the reservoir is filled New rubber tubing should be boiled, stretched, and washed through to remove the chemicals, and boiled again before the apparatus is assembled An interceptor (*Fig* 117) is an integral part of the armamentarium, it should be freed of contained water from the sterilizer before the reservoir is filled The whole apparatus must be seen to be in working order and the filled reservoir suspended suitably before any attempt is made to prepare the patient for the reception of the saline

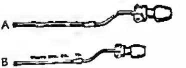


Fig 116 —A Author's cannula, B Cannula child's size They are gold plated to prevent corrosion.

Fig 117 —An interceptor for continuous intravenous saline

Technique —

Choice of the Vein —In general it is best not to use a large vein, one just a little larger than the cannula or needle is most suitable The lower limb can be splinted securely, consequently, in patients who are restless or may become so, the leg as the site for infusion is desirable It is also obvious that it is less irksome

* Manufactured by the Genito-Urinary Mfg Co

3 The reservoir must always be kept more than half full of saline
4 Veins are easily obstructed There should be no bandage over the line
h. vein
5 The rate of flow should be timed and recorded at frequent intervals
6 If the flow stops (a) Do not pinch the tubing, (b) See if the tubing is
ked, (c) If the flow is not restarted by some simple adjustment of the limb
he tubing, report immediately
7 Watch for and at once report (a) Rigors, (b) Redness along the vein,
Œdema of the feet, face, or arms, and (d) Any sign of respiratory distress
8 Measure the amount of urine the patient has passed If the output is
th n the intake report the matter Also report if the specific gravity becomes

Making up a Balance Sheet (*Fig* 122)—Unless a balance sheet is made up
twenty-four hours we have no check on the patient's requirements I am

CONTINUOUS INTRAVENOUS SALINE BALANCE SHEET

Patient s Name .. ..

ours ending 19	INTAKE		OUTPUT		
TRAVENOUSLY —			URINE {S G a m / S G p m}		pts
* drops per min		pts	Vomitus	...	pts
*G	•	pts	Normally 1½ pints { Fæces	....	pts
C	"	pts	Sweating & Lungs—	say	pts
MOUTH	..				
Total			Total		
OSE — ut on (allow 30 grammes = 120 Calories for each p n) Calories					
s per minute = 6 pints in 24 hours = 3 "					

Fig 122 —Balance sheet. Pads of 50 can be obtained from the Genito-Urinary Manufacturing Co. Ltd.

the opinion that without a balance sheet intravenous saline should
tinued for more than twenty-four hours To run in pints of fluid
ng a check on its disposal is extremely dangerous
olliter.—This apparatus is ideal for use in an emergency, for it is
itely, and the sterility of both the apparatus and the solution is

us (*Fig* 123) is extremely simple to assemble The metal cap
n lifting off the underlying rubber disc (*Fig* 124) two holes will
topper The butt-end of the glass interceptor is plugged firmly
cated by an arrow (*Fig* 125) The Vacoliter is then inverted
ng on a stand

Keeping the Limb at Rest—

The arm—Either a Carr's splint or plaster strip well padded with Gamgee tissue, with a turn around the wrist, is eminently satisfactory

Fig 120—Cannula full size

The leg—A posterior splint with a footpiece is serviceable (*Fig* 121) Alternatively, a Thomas's knee splint can be used The latter has the advantage of ensuring immobilization of the limb when the patient is restless

The Temperature of the Fluid—In spite of the many ingenious devices which have been put forward for keeping the fluid warm, the simplest appears to be the best—namely, the patient's leg or arm into which the saline solution is flowing is kept warm with a hot water bottle or an electric heating pad In addition to simplicity, this leaves the reservoir and the delivery tube in full view

The Rate of Flow—The average rate of flow for an adult in need of fluid should be 50 drops per minute—that is, a quarter of a pint per hour, or six pints in the twenty four hours In urgent cases, for the first hour the rate of flow is often accelerated to 100 drops per minute to see how the patient responds If the blood pressure is increased satisfactorily, we are encouraged to proceed with the measure When in doubt as to how much fluid the patient should receive, the flow should be cut down to 30 drops a minute—that is, approximately three and three-quarter pints in the twenty four hours, a dose which at any rate is unlikely to harm him

The Administration—The actual administration is largely in the hands of the nursing staff It is of paramount importance to be sure that the nurse appreciates the simple, yet vital, responsibilities connected with the care of the apparatus and the maintenance of strict asepsis

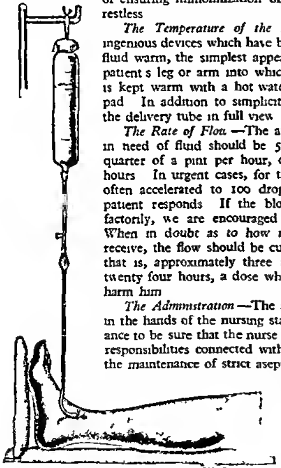


Fig 121—Apparatus in use. In very ill patients who are restless or may become so the limb can be placed in a Thomas's splint with advantage

The nursing instructions are simple, and can be carried out by a conscientious State registered nurse, providing that she receives special instructions if she has not been trained in the method

Nursing Instructions—

1 Every utensil used in the transfer of the saline to the reservoir must be absolutely sterile

2 To prevent the entry of bacteria from the air, the top of the reservoir must be covered with sterile gauze

3 The reservoir must always be kept more than half full of saline

4 Veins are easily obstructed There should be no bandage over the line of the vein

5 The rate of flow should be timed and recorded at frequent intervals

6 *If the flow stops* (*a*) Do not pinch the tubing, (*b*) See if the tubing is kinked, (*c*) If the flow is not restarted by some simple adjustment of the limb or the tubing, report immediately

7 Watch for and at once report (*a*) Rigors, (*b*) Redness along the vein, (*c*) Œdema of the feet, face, or arms, and (*d*) Any sign of respiratory distress

8 *Measure the amount of urine the patient has passed* If the output is less than the intake report the matter Also report if the specific gravity becomes low

Making up a Balance Sheet (*Fig* 122)—Unless a balance sheet is made up every twenty-four hours we have no check on the patient's requirements I am

CONTINUOUS INTRAVENOUS SALINE BALANCE SHEET

Patient's Name .. ..

24 hours ending 19	INTAKE	OUTPUT	
INTRAVENOUSLY —		URINE {S G .. a m / S G p m}	pts
*@ drops per min	pts	Vomitus	pts
*@ " "	pts	Normally 1½ pints { Fæces ..	pts
@ " "	pts	Sweating & Lungs—say	pts
BY MOUTH			
Total		Total	
GLUCOSE — 5% Solution (allow 30 grammes (120 Calories for each pint) Calories			
*50 drops per minute=6 pints in 24 hours			
*30 " =3⅓			

Fig 122 —Balance sheet Pads of 50 can be obtained from the Genito-Urinary Manufacturing Co Ltd

definitely of the opinion that without a balance sheet intravenous saline should never be continued for more than twenty-four hours To run in pints of fluid without keeping a check on its disposal is extremely dangerous

The Vacoliter —This apparatus is ideal for use in an emergency, for it is ready immediately, and the sterility of both the apparatus and the solution is unquestionable

The apparatus (*Fig* 123) is extremely simple to assemble The metal cap is removed. On lifting off the underlying rubber disc (*Fig* 124) two holes will be seen in the stopper The butt-end of the glass interceptor is plugged firmly into the hole designated by an arrow (*Fig* 125) The Vacoliter is then inverted (*Fig* 126) and hung on a stand

To prevent air collecting in the tubing, the latter is coiled round the hand and held above the level of the interceptor before the clamp compressing the tube is released

Fig 123 —The apparatus is taken out of its sterile package

Fig 124 —The metal cap is removed On lifting off the underlying rubber disc two holes are seen in the stopper

Fig 125 —The butt end of the glass interceptor is plugged firmly into the hole designated by an arrow

Fig 126 —The Vacoliter is then inverted and hung on a stand.

CONTRA-INDICATIONS TO INTRAVENOUS SALINE

Continuous intravenous saline, used intelligently, is an extremely valuable addition to the treatment of many urgent surgical conditions The contra-indications to its use are few, but they are definite, and should be noted carefully

1 *The Failing Heart*—A history of dyspnœa on exertion, uncompensated valvular disease, or any possibility of cardiac weakness should call for hesitation in increasing the bulk of circulating fluid When in doubt as to whether the poor pulse is due to cardiac weakness or to another cause, I have many times placed the patient on continuous intravenous saline and coramine, and waited for an hour or more to see if the blood-pressure improves If it does, the flow is reduced to 30 drops per minute and the patient is again visited after a lapse of an hour or so

2 *Pulmonary Congestion*—In all conditions where there are signs of œdema or consolidation of the bases of the lungs the method is most inadvisable

3 *Hypertension*—If the blood-pressure is high it is obviously courting danger to burden the circulation still further

4 *Bright's Disease*—In all its stages this disease is a grave contra indication On the other hand, in obstructive anuria and oliguria, after the obstruction has been removed, and in many of the surgical uræmias, continuous intravenous saline—or better, continuous intravenous sodium sulphate (made by dissolving 42 85 g of Glauber's salt in one litre of water)—used with discretion is a real therapeutic advance

CONTINUOUS INTRAMUSCULAR INFUSION

When fluid is given intramuscularly the danger of pulmonary œdema is remote If more fluid is administered than can be absorbed, it causes local œdema This route for administration of fluid, therefore, offers some advantages The best site for the injection is the external side of the middle third of the thigh (*Fig* 127) Billimoria and Dunlop's needle, with its adjustable shield (*Fig* 128), is an asset

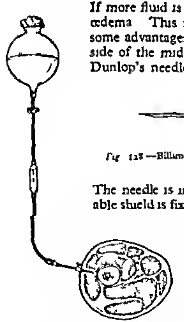


Fig 127 —Continuous Intra muscular administration of fluid in the lateral aspect of the middle third of the thigh.

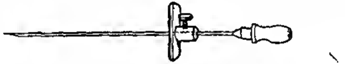


Fig 128 —Billimoria and Dunlop's needle for intramuscular administration of fluid (*Made by Messrs Thackray*)

The needle is inserted nearly down to the bone, when the adjustable shield is fixed by turning the screw, making further penetration impossible It is a good practice to insert the needle through a piece of sterile gauze, which comes to lie between the shield and the skin Once the needle is in place satisfactorily it can be kept in position by adhesive plaster placed over the shield A rate of about 40 drops a minute is suitable for most adults in need of fluid When both thighs are used, a Y-shaped glass connexion is interposed in the tubing leading from the flask. Each tube leading from the Y-shaped

connexion should possess an interceptor, so that the flow to each thigh can be regulated

SUBCUTANEOUS SALINE INFUSION

The apparatus for administering saline subcutaneously consists of two sharp-pointed aspirating needles which are attached to some form of infusion apparatus by a Y-shaped glass connexion The subcutis beneath the breasts is usually chosen for the injection. The skin is sterilized and the sterile needles are inserted with the saline already flowing. They are kept in place with adhesive tape The temperature of the fluid should be about 112° F, it cools considerably while passing through the tubes The container is raised to a height of 3 ft. The saline must gravitate at such a rate that there is no undue swelling of the subcutaneous tissues It is often possible to give two or more pints of saline by this method without removing the needles

This mode of administration of saline is inclined to be painful It cannot be continued for more than a matter of hours, and the tendency is to replace it by the more certain methods described already

CHAPTER XII

BLOOD TRANSFUSION

By Norman M Matheson

It is unjustifiable to proceed with a transfusion, however urgent, without first performing an individual compatibility test For methods of performing these tests, *see* Chapter V

Preliminary Requirements —Since severe albuminuria contra-indicates a transfusion, *the patient's urine is tested as a routine* A high degree of acidity calls for the early administration of alkalis by mouth or intravenously A prospective donor, free from constitutional or communicable disease, is then obtained, when possible, a young healthy male is selected and the blood taken while fasting

Fig 129 —Ampoule containing 50 c c of 3 8 per cent sodium citrate solution

Collecting the Blood —

Amount —This varies according to circumstances, but from 500 c c to 650 c c is a usual amount for a single transfusion in an adult Smaller quantities, e g, 300 c c, are given when it is anticipated that the process will be repeated *In infancy 15 c c. of blood are recommended for each pound of body-weight*

Concentration of the Solution —Standard preparations of sodium citrate are now obtainable sterilized and ready for use

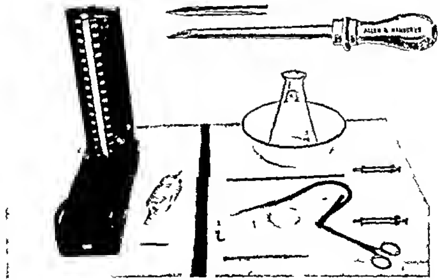


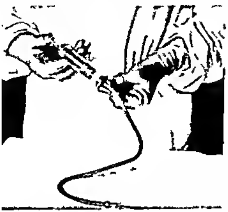
Fig 130 —*Instruments in readiness for collecting blood* Ether for sterilizing the skin is placed in the gallipot, two syringes are employed one being filled with novocain and the other (without needle) with citrate to run through the tubing and needle before use *Inset* French's blood-collecting needle

; 129) The *stock solution* is supplied in an isotonic (3 8 per cent) con-
tration, and the blood is added in the proportion of five parts to one of the
ate solution If *powder* is used, 1 g of the salt in 50 c c of sterile
m water is added to each 450 c c of blood (G Keynes)

Apparatus —The simple apparatus in *Fig* 130 is all that is needed

Operative Technique —

The donor lies with his bared arm abducted to a right angle His elbow, l extended over a sandbag, is supported on a separate table Having obliter- l the *venous* circulation (about 40 mm of Hg) by inflating the cuff of a Baumano- er applied high above the elbow, the antecubital region is prepared with ether decked with sterile towels On no account should the arm of a blood donor



131 —Citrate solution is run through the tube and dle. This precaution obviates clotting therein.

be prepared with iodine An injection of a few minims of 1 per cent novocain anæsthetizes the skin over an appropriate vein A skin incision of insignificant length directly over the selected vein simplifies the insertion of the needle A deliberate dissection is seldom necessary and is permissible only when the donor is a friend or relative of the patient To forestall clotting a small amount of citrate is run through the tubing and its attached needle (*Fig* 131) With the point directed towards the donor's hand, the needle is thrust into the vein and blood flows through the tubing into the flask This is held by a nurse in owl of warm sterile water and constantly but gently rotated

The flow of blood is hastened by requesting the donor to clasp and unclasp hand, but this should not be resorted to unless it is necessary One must areful to steady the needle while the movements are in progress, or the needle become displaced When the requisite quantity of blood has been obtained pneumatic tourniquet is removed, the needle withdrawn, and the puncture ed

Treatment of the Donor —The donor, who is placed in the care of a nurse, is kept n and supplied with light nourishment He should remain recumbent for two rs (or more if necessary), and be excused from work for the rest of the day When transfusion is completed, he is interviewed by the surgeon and instructed to return examination of the arm on the next morning

Care of the Collected Blood —The citrated blood is gently stirred with ass rod by an assistant who sees that the water in the surrounding bowl is t at 100° F To remove froth, the solution is strained through folded gauze re being transferred to the recipient

Administration of the Blood —

Choice of a Vein —In the majority of cases a vein of the forearm is accessible, ough in anæmic and severely shocked patients difficulties not infrequently e owing to the small size of the collapsed antecubital vessels, in stout subjects their identification is sometimes troublesome, and previous intravenous

medication occasionally prohibits their use Under such unfavourable circumstances the internal saphenous vein is chosen, and the injection given either in Scarpa's triangle or as the vessel courses anterior to the internal malleolus The latter situation is especially convenient in childhood and has obvious advantages when a transfusion is required while a major operation is in progress

Technique—Citrated blood is administered to the recipient in precisely the same way as a massive dose of normal saline is given (p 78) The simple apparatus (*see Fig 112*) *is filled with saline, and once the saline is seen to be flowing* into the veins satisfactorily, the blood is poured from the receptacle into the reservoir, through gauze Finally, before the cannula is removed, a few ounces of saline are permitted to gravitate into the vein This ensures that every drachm of blood is utilized

The administration of the blood must proceed slowly, at least twenty minutes being taken to give 700 c c Throughout the procedure a strict watch is kept for any untoward symptoms, particularly during the administration of the first 50 c c The occurrence of such symptoms calls for immediate cessation of the operation

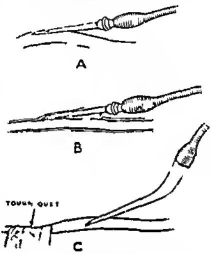


Fig 132—Technical obstructions to flow of blood A Angulation of cannula so that tip impinges against wall of vein, B Cannula insinuated along fissure in adventitious coat C, Failure to remove tourniquet

The closed method of administering the blood—It is only when the veins are particularly large that the closed method of injection is to be attempted by the beginner, with practice, of course, more and more often this method can be used *Only* too often in patients requiring transfusion are the collapsed veins of so fine a calibre as to preclude the direct insertion of a needle *into* the *lumen* and an open dissection becomes imperative

A sharp French's needle replaces the cannula employed in the above description With the saline running, the point of the needle is thrust into the lumen of the vein *and the tourniquet relaxed Thereafter* the transfusion proceeds by adding the blood

Technical Difficulties—Failure to secure an even flow of blood occasionally mars *the successful issue of one's early transfusions* This *condition is often* due *to such* minor technical errors that a knowledge of their possibility leads to ready rectification (*Fig* 132)—

1 Angulation of the needle so that its tip impinges against the venous wall

2 Incomplete or inaccurate exposure of the lumen of the vein, the needle being insinuated along a fissure in the adventitious coat of the vessel

3 Failure to relax the tourniquet—a trivial imperfection of technique, but *easily* committed in a difficult transfusion under circumstances of extreme urgency

CONTINUOUS DRIP BLOOD TRANSFUSION

The technique for the continuous drip transfusion of blood is now well developed and the method has a large field of usefulness in many of the hæmorrhagic states

Although the blood is administered in large amounts, the procedure occupying several hours or even a matter of days, its delivery is slow and at all times under control The dosage is regulated according to individual requirements, the principle being to restore the hæmoglobin percentage to the lower limits of normality (H L Marriott and A Kekwick)

Donors—From relatives or friends of the patient a number of healthy donors are selected whose blood is proved compatible with that of the patient, all donors must belong to the same group

Collection of the Blood—While the transfusion is in progress, further blood is taken from the additional donors in relays, being collected into a 3 8 per cent solution of sodium citrate by a closed method

Selection of a Vein—To avoid compression of the cannula by the flexed elbow the middle of the forearm is the site of election, and any convenient vein in that situation is chosen Should the veins of the forearm for any reason prove unsuitable, the internal saphenous as it passes in front of the internal malleolus is utilized

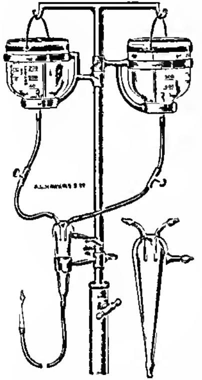


Fig 133—Officer's apparatus for continuous drip blood transfusion. One receptacle contains blood and the second saline so that either fluid may be administered alternately

Armamentarium—The apparatus designed by R Officer is particularly valuable for continuous transfusion (*Fig* 133) An additional advantage is that either blood or saline can be administered alternately—a distinct recommendation in those surgical states in which chloride loss is to be repleished.

On a stand are supported two receptacles—one for *saline*, in the form of a Vacoliter (*see* p 83), and the other for *blood*, working on the principle of the Transfuso Vac (*see* p 91) The exit tube of each vessel passes to a central two way drip bulb In the course of these tubes is a regulating clip, by this means it is possible to divert either blood or saline to the central drip bulb and so administer from that source either blood or saline to the single delivery tube which leads to the patient

In order to regulate the level of the fluid, the central bulb has a lateral nipple, to this is attached a small piece of rubber tubing which can be compressed by a screw-clip

Technique—Fill each receptacle with the appropriate fluid Release the adjustable screw so that saline flows through the delivery tube and insert the cannula, after eliminating air bubbles, into the selected vein of the prepared forearm Retain the cannula in position by adhesive strapping applied to the skin and regulate the rate of the saline to from 30 to 40 drops per minute When it is desired to administer blood, the clip controlling the saline is closed and that controlling the blood is opened and regulated to the requisite rate of about 40 drops per minute

Practical Considerations—

1 A *hæmoglobin estimation* is made at the commencement of the transfusion and repeated at intervals during the operation

2 *Bandaging* When applying dressings to the arm after the cannula is in place particular attention should be paid to avoid occlusion of the venous circulation by bandages applied above the cannula

3 *Splinting* As a rule it is not necessary to restrict the movements of the limb Should, however, the patient be restless, the arm is steadied by a light plaster case or a straight wooden splint A back splint answers well for the leg When splints are necessary, care is likewise taken to avoid proximal venous compression

4 *Rate of flow* Marriott and Kekwick find that 40 drops per minute is convenient for many purposes, but the rate is modified to conform with individual requirements, being slower when the patient is weak or suffering from cardio-vascular or respiratory disease

5 *Warming of the blood* No special precautions are taken for maintaining the blood at body temperature, for, if the patient is kept warm, blood heat is soon established

6 *Changing of veins* Each day, or earlier if there is pain or other evidence of local irritation, the cannula is inserted into a different vein

7 The nurse in attendance should be specifically instructed in the principles of continuous intravenous therapy and thoroughly familiar with the apparatus employed She maintains the flow at the prescribed rate, and should report any obstruction, or the onset of pain, and see that the containers are at all times sufficiently filled

TRANSFUSION WITH THE 'TRANSFUSO-VAC' (BAXTER)

This is a remarkably simple and efficient means of performing blood transfusion, and, being a closed method, the blood can be stored if not used forthwith

Fig 134 —Connecting the donor set and 'Transfuso-Vac' by piercing the rubber diaphragm and stopper at the point indicated

1. Armamentarium —The apparatus consists of three units —

a The '*Transfuso-Vac*'—This is a doubly sealed vessel containing the citrate in a vacuum

b The *Donor Set* —This includes a needle, tubing, and a specially designed valve The latter has a pointed prolongation so as to pierce the appropriate opening in the container

c The *Infusion Assembly*—Consists of a needle, a length of rubber tubing, and a stainless steel filter drip

2. Assembling the Apparatus—The 'Transfuso Vac' is opened by breaking the seal, raising the metal disc, and removing the first rubber diaphragm with aseptic precautions

The donor set and container are connected by piercing the rubber diaphragm and stopper of the 'Transfuso-Vac' in the position indicated on its upper surface with the pointed end of the valve of the donor set (*Fig* 134)

3 Collection of the Blood—The forearm of the donor is prepared in the usual way and the needle of the donor set inserted Its valve is slowly opened by rotating the knob in an anti-clockwise direction The withdrawal of blood then commences (*Fig* 135), the rate of flow being regulated by opening and closing the valve During the process gently rotate the container so that the blood and citrate become well mixed

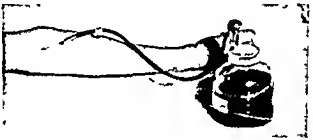


Fig 135—The needle of the donor set has been inserted into a vein and the blood flows after the knob of the valve has been rotated in an anti clockwise d rection.

Having secured the desired quantity, close the valve and remove the needle Hold the container firmly, and slowly detach the donor set In so doing, the rubber disc and diaphragm become automatically sealed, so that the blood is then enclosed within a vacuum

4 Administration—This presents no difficulty Under aseptic conditions cut the rubber diaphragm on the smaller (upper) surface of the 'Transfuso-Vac' and attach the infusion tube and needle assembly

The rate of administration of the blood is controlled by the screw clip on the tubing, the container being inverted and suspended by its handle to a stand throughout the transfusion

STORED BLOOD

The advantages of having a supply of blood stored and ready for use have long been apparent Having now overcome those technical difficulties which prohibited its general use, the method is being widely used with results which, after the observance of certain precautionary measures, rival those of fresh blood. Naturally cases of urgency make the greatest demand on the newer method All apparatus, particularly rubber tubing, must be scrupulously clean

Source of the Blood—Blood of *voluntary donors* is most often employed For storage purposes, blood of donors belonging to Group O is in particular

demand Not only are these 'universal donors', but members of this group form a large percentage of the population Blood of the *cadaver*, taken a few hours after sudden death, has been utilized, and that of the *placenta* can also be extracted for storage

Anti-coagulant and Preservative.—Sodium citrate, proved to be safe and satisfactory in the long trial of the former techniques of blood transfusion, is fortunately an adequate anti-coagulant for conserved blood The addition of glucose is important as it prevents hæmolysis during storage The anti-coagulant solution recommended by the Medical Research Council consists of 100 c c of 3 per cent sodium citrate in distilled water to which is added 20 c c of 15 per cent glucose in distilled water 120 c c of this anti-coagulant solution is used for 420 c c of blood

Container.—As elaborate apparatus is unnecessary, a graduated glass bottle meets practical requirements If possible it should be fitted with a screw cap—an addition which possesses advantages in preventing aerial contamination during storage Special containers are also obtainable with two-way stoppers, which can be attached to a filter and drip connexion For emergency use the Medical Research Council have modified a pint milk bottle so that it can be used for taking, storing, and giving blood The bottle (*Fig* 136), which is slightly waisted to facilitate handling, is fitted with a screw cap and a rubber diaphragm Graduations mark two levels, one at 180 c c. and the other at 540 c c It should be noted that these originally denoted the amount of anti coagulant and blood respectively, but as the volume of anti-coagulant formerly used has been changed, the former is irrelevant Filtration is effected by a gas mantle or glass beads A metal band surrounds the base of the bottle, to this is attached a handle so that the container can be suspended in the inverted position, thus allowing the blood to flow directly from the flask in which it is stored as the transfusion proceeds

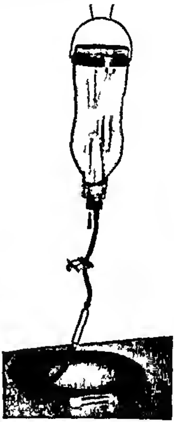


Fig 136—M R.C. blood transfusion outfit with gas mantle filter gate clip regulator and needle protected in test tube

Tubes for Blood Testing—Two small tubes should be set aside so that blood may be collected without disturbing that of the container Into one of these is run blood for the Wassermann reaction and the other (citrated) receives blood for cross-matching

Collection of the Blood—As every possible risk of infection is to be eliminated, the blood is to be obtained by a closed method The bung of a container is pierced by two glass tubes One is connected by rubber tubing to the needle to be used for withdrawing the blood The second glass tube is attached to a length of rubber tubing (interspersed with three cotton-wool filters) and connected

to the electric suction apparatus of the operating theatre Failing this, sufficient negative pressure can be obtained by a Potain's aspirator or by the use of a motor tyre foot-pump with its valve reversed so that it sucks instead of blows

While the blood is flowing, the container is gently rotated to encourage mixing of the blood with the citrate Having secured the requisite amount, the flask is closed, if possible with a screw cap, by an assistant The operator now allows small quantities of blood to flow into the two small tubes previously placed in readiness—one for grouping and direct matching and the other for the Wassermann reaction The former is attached to the container with adhesive strapping

Most important is the correct labelling of the container Essential data to be recorded are (*a*) Date of collection, (*b*) Blood group, and (*c*) Name of the donor

Storage —*The blood must be protected from the light, and should be placed* in a refrigerator, where it is kept at a temperature of 2° to 4° C Although citrated red blood cells may remain intact for a longer period, the blood should preferably be used within a week or ten days Always examine for hæmolysis, which can be recognized by the naked eye, before the transfusion and discard the blood if the supernatant plasma has turned red or if the area of discoloration extends for more than 0 5 cm into the supernatant plasma

Administration —Never omit to match the patient's plasma with the conserved blood before commencing the transfusion The technique presents no difficulty not previously detailed, for either the tube and funnel or the continuous drip apparatus can be used Never stir or vigorously shake, gentle rotation or simple inversion of the bottle is all that is required Administer slowly at body temperature and always filter either through gauze (6 layers), or gas mantle, or by means of beads added to the blood immediately before use

TRANSFUSION OF BLOOD-PLASMA

In severe degrees of shock, the loss of plasma into the tissues and at the site of injury leads to a concentration of cells within the vessels, especially the capillaries There is a rise in the hæmoglobin percentage and in the red cell count It is this hæmo-concentration which forms a dominant feature of the pathological picture seen in the course of extensive injuries and in the secondary shock which is such a dreaded complication of burns

The falling blood pressure calls for fluids, but surely it is *more logical to administer* plasma than to add blood to a system already containing an excess of red cells Thus, *burns* and *serious accidents* without loss of blood appear to be rational indications for plasma transfusions

In severe *hæmorrhage*, the passage of fluid from the tissues to the blood is an essential part of the recovery process The effect in controlling the blood pressure is, unfortunately, transient, as the incoming fluid dilutes the circulating protein In the absence of whole blood, plasma with its all important proteins is the fluid of preference for restoring the osmotic relations and so maintaining the blood pressure

Citrated Plasma —

Preparation —The blood is collected into citrate solution as for transfusion After standing in an ice chest, the plasma is obtained by removing the supernatant layer when sedimentation has occurred This must be performed by a syphon or pipette under a strict aseptic ritual. As, however, there are certain technical difficulties to be overcome in the prevention of contamination and in filtration the preparation of plasma is generally undertaken by specially trained laboratory workers

Standard Preparation Human plasma is now available for emergency use supplied in screw-capped M R C bottles, each contains 540 c c in citrate-glucose-saline, with merthiolate 1–10,000 as an antiseptic

Storage —One of the great features of plasma is that it can be kept in a refrigerator for some months at 4° C without much deterioration in its efficiency As it readily becomes contaminated, merthiolate (1–10,000) is added for its bacteriostatic properties

Grouping —While grouping is unnecessary when usual amounts of plasma, e g, 540 c c, are administered, this important consideration should receive attention when large quantities are to be given Then plasma belonging to group AB is suitable, for it contains no agglutinins, or matched plasma can be employed By pooling the blood of groups A and B before syphoning the plasma, a mixture containing very little agglutinin is obtained

Preliminary Warming —Plasma is to be warmed before use It is suggested that the bottle be placed in warm water (40° C) for 15 to 20 minutes before administration and occasionally rotated

Administration —Plasma is given in the same way as a drip-blood transfusion, filtration being effected by means of a gas mantle or beads

Rate of flow This is naturally governed by the state of the patient Slow administration is usually advised, but in an urgent case a rate of 100 drops per minute can be used

Dried Plasma —The plasma may be dried by evaporating at a low temperature under reduced pressure, a yellow crystalline powder being produced This powder consists of all the protein and crystalline elements It may be stored in sealed ampoules at room temperature for a very considerable period of time, and when needed is dissolved in warm distilled water—250 c c. of distilled water to 20 g of the powder to re-form pure plasma (F R Edwards)

Dried plasma should be reconstituted only for immediate use and never for storage as a fluid

REACTIONS FOLLOWING BLOOD TRANSFUSION

Headaches, vomiting, and isolated rigors occur without serious effect in a fair percentage of cases and are treated symptomatically Moderate fever is not necessarily a reaction Some recent observers are of the opinion that such reactions are no commoner with properly stored blood than with fresh blood There seem to be no reactions distinctive of conserved blood Blood from the cadaver, however, is said to give more frequent and more severe reactions than blood from donors

More serious, however, are the anaphylactic phenomena which are sometimes seen while the blood is being given or soon after the transfusion has been completed Owing to sensitization, such reactions are said to be particularly likely to occur when the same donor is employed for a second transfusion on the same recipient Fever, nausea, dyspnœa, and circulatory collapse are presenting symptoms, with, perhaps, rashes of an urticarial character Should any such symptom develop, the transfusion is at once stopped, the head of the table lowered, and adrenaline (0 5 c c of a 1–1000 solution) injected subcutaneously Morphia is given if restlessness is severe

Hæmolytic reactions due to incompatibility of the blood usually become evident soon after the transfusion has begun, but might be delayed for several hours, pain, particularly in the lumbar region and chest, is a prominent early complaint There are signs of respiratory distress with cyanosis and circulatory failure Jaundice and hæmoglobinuria may occur Suppression of urine from

precipitation of hæmoglobin in the renal tubules leads to uræmia, which is a common cause of death

On the occurrence of any adverse symptom, the operation is immediately interrupted and collapse treated by the usual methods Alkalinization of the urine is important, this is effected by injecting 2 per cent sodium bicarbonate intravenously and by administering potassium citrate and sodium bicarbonate by the mouth for at least a week afterwards

Apart from faulty grouping, N S Plummer has indicated that heart failure can occur secondary to ordinary transfusion reactions in patients with long-standing anæmia or heart disease

CHAPTER XIII

GASTRIC, DUODENAL, AND INTESTINAL ASPIRATION

By Hamilton Bailey

ASPIRATING THE CONTENTS OF THE STOMACH

No patient should be allowed to suffer the misery of repeated vomiting, in all conditions where vomiting is repeated the stomach content is watery and can be aspirated easily Gastric aspiration is a great advance and there is a wide field for its application The practitioner might well carry an aspirating tube and use it in the patient's home

Gastric Aspiration by the Nasal Route (*Fig* 137) —The nasal route for the passage of the tube is usually the best Once the tube is in place, it can be left in situ for hours or even days without the slightest discomfort, indeed, even the patient who rebels against its passage soon appreciates the comfort of having the contents of the stomach aspirated A small Ryle's tube (*Fig* 138) can be used, but the author's tube (*Fig* 139) is a little easier to pass, for it contains a coiled spring in the distal end which helps to stiffen the tube I used to cocainize the nose and back of the throat, but this is unnecessary A good method for a nervous patient is for him to suck a pastille of decicain 1 gr twenty minutes before the passage of the tube Sister McCluskey, of the Royal Northern Hospital, has evolved a technique which is extremely efficient The tube is first placed in ice-cold water After the end has been passed down the nose and made to enter the nasopharynx, the patient is given sips of water (*Fig* 140) With each gulp

Fig 137 —Gastric aspiration via the nose

Fig 138 —Ryle's tube

Fig 139 —Hamilton Bailey's tube for aspirating the stomach via the nasal route

the tube is passed onwards until it is well within the stomach Once the tube is in place it is fixed by adhesive strapping to the cheek Aspiration can be carried out with any suitable syringe, but a well-fitting Janet's 6-oz glass syringe with a metal plunger makes for a perfected technique

With a tube through the nose the patient can drink as he pleases, for, if necessary, the fluid can be aspirated soon afterwards This, indeed is an effective way of washing out the stomach

Fig 140—Passing the gastric aspiration tube

Fig 141—Emptying the stomach. Janet's 6-oz. syringe which is shown in use is much better than the smaller syringes which are usually employed

Management.—In most instances it is essential to know how much the patient would vomit if the tube was not in place. The house-surgeon must, therefore, instruct the nurse as follows: Say, the gastric aspiration tube was passed at 9 a.m.,

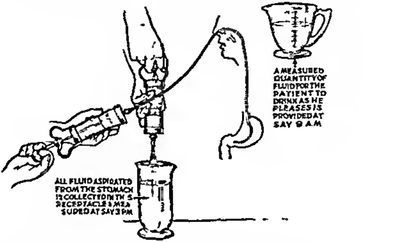


Fig. 142.—The principles involved in recording and charting the amount of fluid aspirated from the stomach.

two pints of fluid are allotted to the patient and he may drink this as he pleases. All the contents which are aspirated (*Fig.* 141) are collected in a bucket. At, say, 3 p.m. the contents of the bucket are measured and the quantity that he has drunk is subtracted therefrom (*Fig.* 142). This will give the amount of regurgitated fluid in the six hours. The figure is charted, and where necessary the same procedure adopted for the next six hours.

As a rule the gastric aspiration tube is not left in place more than forty-eight hours. After this time it is advisable to remove the tube and boil it, after which it can be replaced if necessary, preferably through the contralateral nostril. This will prevent erosion of the nasal mucosa which sometimes occurs when the tube remains in the same position for long periods.

Final removal of the tube. Before withdrawing the tube finally it is a good practice to give a 'gastric mobility test.' The patient drinks half a pint of barley water coloured with cochineal or indigo-carmine. If after one and a half hours none of this coloured fluid can be aspirated, it is proof positive that the stomach is passing its contents onwards and aspiration is no longer necessary.

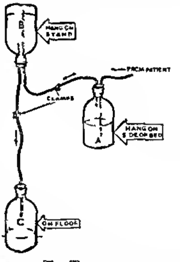


Fig. 143.—The Wangensteen apparatus for continuous aspiration of the stomach.

Continuous Gastric Aspiration.—To connect the gastric aspiration tube to some form of suction apparatus ensures that the stomach is kept empty constantly. In order to improvise a suction apparatus three Winchester quart bottles are required (*Fig.* 143). The stomach contents are collected in bottle A,

in which a negative pressure is established by water gravitating from bottle B to bottle C When the time comes for bottle A to be emptied, the screw-clamp connecting it with the suction apparatus must be screwed up tightly, otherwise the water will run out of bottle B

Aspiration conducted continuously is efficient, but from the therapeutic standpoint it has little, if any, advantage over syringe aspiration carried out by skilled nurses

INTESTINAL ASPIRATION

The Miller-Abbott Double-lumen Tube* (*Fig* 144)—The Miller-Abbott tube for small intestinal intubation has made aspiration of the contents

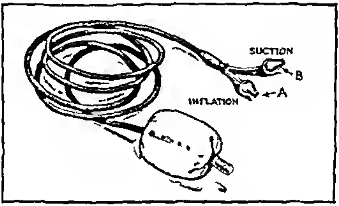


Fig 144—The Miller Abbott tube.

of the small intestine possible This form of therapeusis has opened up a new field in the preparatory stages of the treatment of advanced intestinal obstruction It may well prove a life-saving measure in paralytic ileus

The Miller-Abbott tube is a double-channelled rubber tube of considerable length, and has its lumen bifurcated throughout, viz  The small channel is used to inflate the balloon, the larger to aspirate the contents

Method of Introduction—The air is withdrawn from the balloon by connecting a Record syringe to A The last few inches of the tube are lubricated with K Y jelly or a similar lubricant Before attempting to pass the tube it is advisable to cocainize the pharynx. When the tube has reached the pharynx it may be necessary to aid its passage down the œsophagus with a pair of sponge holding forceps manipulated through the mouth

When the end of the tube is well within the stomach the patient is instructed to lie upon his right side and the tube is advanced inch by inch until the third mark on the tube (75 cm) reaches the nose A smoothly working 20-c c. Record syringe is then connected to the lumen A leading to the balloon Ten c c. of air is injected If a sense of rhythmically recurring resistance is felt to the injection of a further 1 c c of air, the air is left in the balloon for twenty minutes At the

* The tube is made by the G P Pilling & Son Co Philadelphia. The nipples A and B do not fit British-made syringes. Messrs John Bell & Croyden London have altered these nipples so that A fits a Record syringe and B a Janet s syringe.

expiration of this time, if the resistance can still be felt, the amount of air in the balloon is increased to 25 c c and the opening A is plugged so that the air does not escape If no resistance is felt, one must wait a further half-hour and try again

The patient is allowed to swallow about 6 in of the tube every half hour, aspiration being carried out at frequent intervals As gas and fluid are sucked out of the gut the intestinal walls contract, and, regaining their tone, force the balloon onwards In this way the tube is carried down to the point of the obstruction, or, in the case of paralytic ileus, to the inactive segment of gut which it is so vital to empty The tube can be left in place for days, if necessary

The stomach contents should not be emptied by aspiration, for when the stomach is dilated it is traversed more easily by the tube and the pylorus is more likely to be open Suction is deferred until the duodenum is entered A radiograph taken with the portable machine is a great aid in telling whether the end of the tube has passed through the pylorus

Removing the Tube—As with the gastric aspiration tube, there should be no haste in withdrawing it The tube can remain in position without aspirating the contents, and only when it is evident that a relapse is improbable is the tube removed The bag is deflated, and with gentle traction the tube is slowly withdrawn, taking about ten to fifteen minutes over the process

CHAPTER XIV

THE ADMINISTRATION OF ENEMATA

By EVELYN C PEARCE

IN order to get the best result, it is desirable that an evacuant enema should be retained for at least fifteen minutes For this and for other reasons, the patient should be told the purpose of an enema and his co-operation sought

Technique—Two principles have been invoked (*a*) force (Higginson's syringe), (*b*) gravity

Higginson's Syringe—This method is falling into disuse The rigid nozzle constitutes a real danger, which is only circumvented by the attachment of a rubber rectal catheter This avoids the possibility of perforating the rectal mucosa, a calamity not unknown when an enema is given by a careless or ignorant person. Another objection is that fluid is injected too forcibly into the rectum. Finally, Higginson's syringe is difficult to sterilize, for it cannot be boiled without detriment.

The Gravitation Method is applicable in every instance Distension of the rectum by a volume of fluid injected rapidly (two pints in five to ten minutes), will result in emptying the bowel, as when an evacuant enema is given By reducing the rate of flow, reflex irritation of the rectum is avoided, and the fluid injected is retained Twenty minutes may be occupied injecting from four to six ounces of fluid, as, for example, when a starch and opium (sedative enema) is given.

The rate of flow is best regulated by means of a clamp on the tubing, alternatively, it can be regulated by the height at which the reservoir or funnel containing the fluid is elevated

Fig 145—Flatus tube attached by means of a glass connexion to a piece of rubber tubing

Preparation of the Patient—If possible, the bladder should be empty The lower bowel should be as free of gas as possible, particularly before giving an injection which is to be retained, to ensure this a flatus tube should be passed A clean flatus tube with a length of rubber tubing attached (*Fig* 145) is brought to the bedside in a bowl of warm water or weak antiseptic lotion, the end of the tube is lubricated, and inserted for several inches into the rectum, the passage of flatus will be indicated by bubbles passing through the fluid in the basin in which the free end of the rubber tubing lies The flatus tube may be left in situ for fifteen to thirty minutes, whilst preparations for giving the enema are completed

Position of the Patient—It is convenient when giving an evacuant enema to have the patient in the left lateral position with his knees drawn up and his buttocks well over to the right side of the bed, against which the nurse stands with the apparatus and prepared injection on a trolley or bedside table The

bedclothing should be re-arranged so that the patient is covered, and is not exposed The injection made, he may continue to lie in this position, and if he experiences difficulty in retaining the enema, or is fraught with the desire to return it immediately, the nurse standing by may press a folded towel firmly against the anus, or press the buttocks together, until this first impulse passes When the time comes for the patient to evacuate, he is turned on to his back and the bedpan inserted If there is delay in having an action, a hot drink may help

Although the left lateral position is a convenient one, an enema can be given with the patient in many positions, and it is often advisable to give the injection without disturbing the patient, e g, in Fowler's position

Preparation of Apparatus—That commonly employed is shown in *Figs* 146 and 147 The articles used should be clean, but need not be sterile After

Fig 146—Reservoir for fluid tubing with control tap inserted, connexion tube and rectal catheter

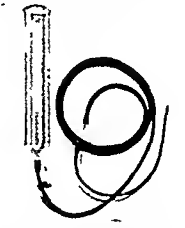


Fig 147—Graduated funnel tubing with controlling clamp attached, connexion, and rubber catheter

use the apparatus should be washed thoroughly and disinfected or sterilized, preferably by boiling for twenty minutes It should be drained and dried before being put away, if this is done, the articles will be ready for use, and then need only be immersed either in warm water or in some weak, non-irritating antiseptic lotion When at the bedside, and before inserting the rectal tube or catheter, the apparatus should be filled with fluid, some being allowed to run through the tubing and into the catheter, so that air is expelled from the apparatus

Lubricant—A rectal catheter should be lubricated with liquid paraffin or vaseline, or some other non-irritating grease It is inadvisable to use glycerin, as by its action the impulse to empty the bowel may be stimulated before this is desirable

Conditions in which an Enema is Contra-indicated—Whenever there has been an injury to, or when an operation has been performed on, the organs in relation to the perineum, the advisability of giving an enema should be considered carefully For example, an enema should not be given for some days after perineorrhaphy, nor for some time after Wertheim's hysterectomy An

enema should not generally be given after an operation on the bladder, in particular, it is contra indicated soon after prostatectomy, because it may initiate bleeding from the prostatic bed In obstetric cases, when there is malpresentation, an enema may cause rupture of the membranes, it is also contra indicated when there has been severe injury to the birth canal and perineum during labour

Report on the Result of an Enema—It is important to observe whether the result consists of a large, soft, solid, normal stool, contains hard fæces, presents any abnormalities, or if the returned enema fluid is merely coloured, and if possible the passage of flatus should be noted

Colostomy Enemata—The gravity method is essential Enemata should not be used in cases of colostomy unless there is some special indication Washing out the colon tends to upset its natural function and induces a state of catarrh When enemata are essential they should be given at the same time each day, preferably in the morning This helps to form a 'habit' of evacuating the bowel at the same time each day The colostomy opening and surrounding skin must be kept scrupulously clean and dry

Preparation of Enemata—Details for the preparation of various enemata are given below Where bulk is not specially indicated, it is usual to give from one to two pints in the case of adults, a smaller quantity being given to children proportionate to the age The temperature of the fluid should be taken, as the rectum is sensitive to heat, and an enema should not be hotter than 80° to 90° F

1 **Soap and Water Enema**—The soap used is important. Soft green soap B.P, 1 oz, is dissolved in 1 pint of warm water Yellow soap is a good substitute Fancy, antiseptic, or soda-containing soaps should be avoided, they tend to produce an extremely irritable, blotchy rash If there are any particles of undissolved soap, the solution must be strained through gauze

2 **Cleansing Enema**—The bowel is washed out with plain warm water until the contents return clear It is used in the final preparation for operations on the rectum

3 **Glycerin Enema**—This is used when it is undesirable to introduce a bulky enema One part of glycerin is mixed with 2 parts of water, or equal quantities of glycerin and water are used, and the total amount not exceeding 5 oz, is given by gravitation The glycerin causes an increased secretion from the mucous glands in the bowel wall, so that the fæces are softened and lubricated.

Pure Glycerin, 1–2 drachms, may be introduced by means of a special glycerin syringe this method is now usually replaced by the use of a glycerin suppository

4 **Olive Oil and Gruel Enema**—One tablespoonful of fine oatmeal is stirred into 12 oz of water, this is slowly brought to boiling point and allowed to simmer for 20 minutes, it is strained through muslin and 5 oz olive oil are stirred in, the enema must be allowed to cool and is given through a rectal tube and funnel at a temperature of 100° This is an emollient enema, and may be given as a routine on the third day after the majority of rectal operations

5 **Olive Oil Enema**—Olive oil, 5–8 oz, is given slowly into the rectum, the buttocks being raised on a pillow This enema is useful in cases of fæcal impaction of the rectum, especially after breaking up a hard fæcal mass digitally, and may be followed some hours later by a soap and water enema A smaller olive oil injection (3 oz) may be given with the object of being retained and having a soothing action on the rectal mucosa—for instance in ulcerative colitis

6 **Turpentine Enema**—Turpentine is valuable in tympanitic distension, it increases peristaltic action and helps to expel gas, ½ to 1 oz. of turpentine is usually employed As a precaution against burning the rectal mucosa with turpentine, an equal amount of olive oil or the white of an egg is added and the whole beaten to form an emulsion This is then added to one pint of soap and water and injected slowly

7 **Ox Bile Enema**—Purified ox bile, ½ fl oz., is mixed with 5 oz. enema saponis This is useful in cases of meteorism or paralytic obstruction and it may be given through a colostomy

8 **Treacle Enema**—A useful evacuant enema which also relieves meteorism. It consists of 10 oz of black treacle added to 10 oz of enema saponis

9 **Starch and Opium Enema**—Starch $\frac{1}{4}$ oz, is stirred into 5 fl oz of cold water brought to the boil and cooled To this mucilage 30 min of tinct opii are added This is given slowly and evenly into the rectum through a catheter and funnel in cases of ulcerative colitis, with the object of checking diarrhœa and reducing tenesmus

10 **Antihelmintic Enema**—This is used for clearing the colon of thread worms It consists of a hypertonic solution of saline (1–2 tablespoonfuls of common salt to one pint of water) Alternatively an infusion of quassia chips may be given For an injection $\frac{1}{4}$ to 1 fl oz of the infusion is added to one pint of water

11 **Coffee and Brandy Enema**—Five oz of strong black coffee are prepared *Having filtered it to eliminate the grounds $\frac{1}{4}$ oz of brandy is added*

12 **Magnesium Sulphate Enema**—One to two ounces of magnesium sulphate may be given either in 4–8 oz of warm water or starch mucilage The mixture should be a 25 per cent solution A stronger solution of magnesium sulphate is irritating to the rectum A magnesium sulphate enema is often employed in cases of head injury in order to reduce intracranial tension

CHAPTER XV

PREPARATION FOR OPERATION*

By JOHN BRUCE

Modern aseptic surgery has made the operation safe for the patient, it is now the aim of surgery to make the patient safe for the operation"—Lord Moynihan

PRE OPERATIVE preparation is largely in the hands of the house-surgeon, consequently his obligations, both to the patient and to his surgical chief, are considerable

Patients presenting themselves for operation fall into two classes—those in need of urgent operation, and those in whom the operation can be performed at a time selected by the surgeon

In the first group, risks must be taken which are unjustifiable in the second, but even in emergency an intelligent interrogation and examination of the patient often reveals salient factors which influence the choice of anæsthetic or indicate important operative and post-operative precautions

In the operations of so called deliberate surgery, the pre-operative care may be simple and straightforward, or fraught with the greatest importance, depending on whether the patient is considered a 'good risk' or a 'bad risk' In the latter event, pre-operative care is directed towards promoting the bad risk to the good-risk class

GENERAL SYSTEMATIC EXAMINATION

It is not enough to examine the prospective site of operation, a meticulous survey of the patient's general state of health must be made soon after admission

History—Apart from the details of the actual complaint, inquiry should be directed to elicit any history of excessive bleeding (hæmophilia), drug idiosyncrasy (as to iodine or morphia), or any unusual behaviour during previous anæsthesia

Mental Outlook should be assessed, and an appropriate atmosphere must be created between the house surgeon and his charge Due allowance may have to be made for a nervous patient

Signs of Other Disease—Obesity, hyperthyroidism, cachexia, and dehydration are generally obvious Each has an important bearing on pre-operative preparation

Dental and Oral Hygiene—The mouth, gums, and teeth must be examined in every case Pyorrhœa and dental caries should be specially noted

Cardiovascular System—The state of the heart has to be assessed in the light of the strain to which it is to be exposed by the operation The examination one commonly sees performed—too often, for the first time when the patient is on the operating table—and the report "Heart sounds clear in all areas" is useless In younger patients (under forty) significant signs are (1) Enlargement

* *Consent for Operation*—No operation should ever be performed without written consent In the case of a minor, consent must be obtained from a parent or responsible relative (*see also* Chapter LXXIII)

of the heart and great vessels, (2) A diastolic murmur, (3) Arrhythmia, (4) Present signs or previous history of congestive heart failure In older patients, heart disease may be present without the above manifestations, and in this event, a history of breathlessness on exertion, swelling of the feet and ankles, or anginal attacks should be considered highly important

The *blood-pressure* is particularly important The house-surgeon who takes the blood-pressure of every patient who has to undergo a major operation is an acquisition If, on his own initiative, he reports in good time to all concerned that a patient has a (previously unsuspected) low blood-pressure, he deserves the highest praise

Respiratory System—Upper-passage catarrh, bronchitis, tuberculosis, and bronchiectasis should be noted, both for their influence on the choice of treatment and selection of anæsthetic, and in the management of the post-operative period

Examination of the Urine—Apart from the special analysis conducted in cases of urinary disease, a routine chemical examination is carried out in all cases, for the presence of albumin, sugar, and acetone If sugar is found, operative treatment has to be postponed until further investigations reveal or deny the existence of diabetes Acetone in the urine is also important, as it indicates the possibility of severe acidosis developing

Examination of the Blood—If there is a suspicion of anæmia, a red blood count should be carried out The house-surgeon who familiarizes himself with the use of a hæmoglobinometer and performs this simple estimation himself will acquire a habit which is bound to prove invaluable in whatever future clinical path he may tread

THE PREPARATION OF THE 'GOOD-RISK' PATIENT

The 'good surgical risk' is the patient without signs of serious disability affecting the systems other than the one to be operated upon, who is well nourished, and of stable mental outlook

Time of Admission—When possible, the patient should be admitted to hospital two days before the prospective operation The house-surgeon should see the patient as soon as possible after his arrival If the examination is well conducted, the patient will acquire great confidence in his surgical attendants For the same reason it is a good practice for the anæsthetist to visit the patient on the day before the operation

Evacuation of the Bowel—*Purgation is unnecessary, indeed, it is harmful,* for it results in irritation of the bowel and dehydration If evacuation of the bowel has been regular, a soap and water enema on the morning of operation is adequate If constipation has been present, the patient should be instructed to take his usual laxative the day before, and on the morning of the operation a soap and water enema is administered

Oral Hygiene—Dental sepsis favours the development of post-anæsthetic respiratory complications In association with dryness, it predisposes to post-operative parotitis If pyorrhœa is present the operation should, if possible, be postponed until the infected teeth have been removed and the gums have healed Milder infection and dirty teeth should be treated by scaling, and, when necessary, temporary filling, and a reasonable degree of mouth hygiene established

Diet—Starvation is as dangerous as purgation, it favours the occurrence of acidosis, and disturbs the gastro-intestinal rhythm In the ordinary case, a

light diet with low residue should be allowed, up to the evening before operation On the following morning, a cup of tea or coffee and a small finger of toast may be permitted three hours before the operation

Fluids —The fluid intake should be generous, to counteract the tendency to fluid depletion in the immediate post-operative period Glucose drinks are specially valuable the day before operation, a jug of glucose solution or orange juice and glucose, should be beside the patient's bed, and he should be encouraged to imbibe it

Sleep —A good night's sleep preceding the operation is most desirable All the necessary pre-operative preparations should be completed early, and a sedative given in the late evening (8 or 9 p m) Nembutal (1½ gr), sodium amytal (3 gr), and soneryl (2 gr) are all satisfactory for this purpose There is no virtue in withholding the drug to see if natural sleep ensues, it is given for the express purpose of allaying worry or emotional disturbance about the morrow's ordeal

Preparation of the Field of Operation —Save in the case of acute emergency, each patient should have a general body bath on admission, and the condition of the skin, especially the area of the operation field, is scrutinized at the first systematic examination The presence of septic spots, or boils, dermatitis of the weeping type, such as occurs in the groin and in the sulcus between large abdominal herniæ and the lower abdominal wall, and scabies with secondary infection, should be regarded as indications for the postponement of any save imperatively urgent operations

Preparation of the Skin —Custom decrees a fairly elaborate ritual of skin preparation How far this is absolutely necessary may be judged against the fact that the wounds of urgent surgery, commonly prepared for the first time on the operating table, behave as a rule just as impeccably as any other

Time of Skin Preparation —As a rule, the skin receives its first preparation on the evening before operation In children, this is unnecessary and may be frightening

In orthopædic cases, e g, bone-grafts it is a common practice to prepare the skin forty eight hours before and repeat the procedure at twelve-hourly intervals In most situations, this is not essential, but in the case of operations upon the hands, and especially upon the feet, repeated preparations ensure greater cleanliness

The Ritual —

Shaving —The operative field, and a generous area of surrounding skin, is well soaped and shaved Dry shaving is inexcusable, and bad for the razor, which should be kept keen and well cared for

In the scalp, a preliminary cropping with barber's hair clippers is desirable, and the use of a shaving brush ensures a more satisfactory lather and an easier task than does a gauze or wool swab In extensive operations on the skull, the whole head should be shaved

In abdominal operations, the whole abdominal wall should be shaved, and, if necessary, the lower chest to the level of the nipples In operations on the knee, shaving from the groin to the ankle is the rule, in compound fractures of the lower leg or foot, preparation to the mid thigh is sufficient

Cleansing of the Skin —The skin derives organisms from two sources—they may be *chance* inhabitants deposited from recent contacts from bedclothes or garments, or *residents*, whose habitat is in the deeper crevices The former can

be removed easily by mechanical cleansing The destruction of the 'resident' organisms cannot be guaranteed by any method of preparation, but there is now more than abundant evidence that the contamination of the clean surgical wounds is not due to them, but to infection from without—from the air of the theatre, or the hands, arms, or throat of the surgeon or his team, or the instruments used, or to contact with organisms during changes of dressing in the post-operative period

Reliance should be placed, therefore, on the removal of the surface 'casuals' by mechanical means The skin is scrubbed with soap and hot water, particular attention being given to folds and crevices, and to the umbilicus in abdominal cases The skin is then dried with a sterile swab, and wiped over with ether or methylated ether

Antiseptic Applications are probably of little significance Tincture of iodine (2½ per cent) is the favourite in this country, and has the virtue of colouring the field of operation It is well to remember the risk of an iodine idiosyncrasy, and to inquire if the patient has had previous trouble from this source, it is also essential to prevent the solution trickling down on to the scrotum when the lower abdomen is being painted

Spirit, mercurial preparations (biniodide, mercurochrome, metaphen), flavine, picric acid, and the dye antiseptics have all been, or are still, used The choice appears to matter little

Covering of the Prepared Area—A sterile towel is the usual covering for the prepared part, it is held in place by a roller or a many-tailed bandage

Preparation of the Skin in Emergency Cases—This is often better deferred until the patient is in the theatre, and under anaesthesia The acute abdomen may be too tender to allow thorough preparation, and in accident cases the exposure and the manipulations may increase the degree of shock if the patient is conscious

Pre-operative Care in Children.—Special considerations arise in relation to pediatric surgery The liability to respiratory and exanthematous diseases renders long pre-operative residence in the ward undesirable The possibility of the young patient having been in contact with infectious diseases before admission should be inquired into

The operation should be postponed if there is pyrexia due to other than the disease for which the operation is being undertaken, and if there has been recent upper respiratory catarrh or tonsillitis

Fig 148—The crucifix method of forestalling operation shock in a young child.

The metabolic processes are very easily upset in childhood, pre-operative starvation, therefore, is even more dangerous in the child than in the adult Diseases themselves associated with malnutrition cause rapid dehydration, glucose deficiency, and acidosis, and the spectre of the dehydrated sick infant is not readily forgotten A high carbohydrate diet is essential, and abundant fluids, reinforced with glucose, and barley sugar to suck are important adjuvants If,

for any reason, the oral administration of fluid is impossible, the intravenous route, via the saphenous vein in front of the ankle, is employed

It is seldom necessary to prescribe a sedative on the night before operation, as in the case of adult patients When such is required, luminal, 1 gr, is useful

Forestalling Shock —In the case of an infant, a good method is to wrap warm cotton wool over as much of the body as possible, and then bandage the baby firmly to a frame, which can be improvised easily (*Fig* 148)

Pre-operative Care in the Elderly —A patient of advanced years often requires special understanding and kindness on the part of the staff The young house-surgeon would do well to bear in mind that the aged are apt to be set in their ways, and too strict an insistence on non-essential routine, or too abrupt a discipline, may spoil the confidential relationship on which much depends

In a more practical sphere, the elderly person is a more serious surgical risk The natural decay of tissues leads to a lowering of the reserves of vitality, especially the 'cardiac' vitality A form of chronic respiratory disease is often present, and there is always a risk of basal pulmonary congestion Dehydration is also common, and, in hospital practice at any rate, so is chronic undernutrition

It is wise, therefore, to insist on frequent changes of posture in bed, on movements of the limbs, on a generous diet, with abundant fluids If the undernutrition is so severe that there is wasting and retention of nitrogenous products, a blood transfusion is indicated before the operation

In elderly males the condition of the prostate should be investigated, it may necessitate postponing the operation until attention has been given to the urinary system, or it may decide the steps to be taken if the almost inevitable post operative retention of urine occurs

PRE-OPERATIVE PREPARATION IN 'BAD-RISK' CASES

Obesity —The obese are bad subjects for operation, especially in middle life or later The cardiac muscle is generally flabby, and the cardiac reserve diminished They are also more liable to respiratory troubles and to the development of local wound sepsis

It is a wise measure to insist on a preliminary period of dieting to reduce the weight before undertaking an operation which is not urgently necessary In emergency operations, of course, added risks must be faced, where possible, chloroform and ether anaesthesia should be avoided

Thyrotoxicosis —It must be appreciated that in a thyrotoxic subject the risks of a minor operation are practically the same as those attending thyroidectomy, the only operative procedure which is justifiable, therefore, apart from those actually of a life saving nature, is the operation for the relief of the thyroid condition The pre-operative management of thyrotoxicosis is detailed in Chapter XXVI

Cardiac Disease —The pre-operative preparation of the cardiac 'poor risk' patient is outside the scope of this section In brief, it may be stated that only life-saving operations are permissible in the presence of cardiac failure, until the heart condition has been treated adequately, and evidence of compensation is forthcoming The whole question must be left in the hands of a physician

Respiratory Disease —Upper respiratory infections favour post operative bronchitis, pneumonia, and collapse of the lung Asthma, on the other hand, does not materially affect the surgical risk, but operation should, if possible, be

avoided during or immediately after an attack The gravest conditions from the surgical point of view are bronchiectasis, lung abscess, and tuberculosis Quiescent tuberculosis often flares up after general anæsthesia, especially in elderly subjects

Extensive respiratory disease is again a matter for expert medical assistance

Diabetes—The pre-operative preparation of the diabetic subject is discussed in Chapter XVI

Dehydration.—About 70 per cent of the body-weight is made up of the body fluids Depletion of these fluids is now recognized as a common and important side effect of many surgical states in addition to those like pyloric stenosis, in which it is very obvious Normally, 2½–3 litres of fluid are lost each day—1½ litres in the urine, and 1–1½ litres by evaporation from the skin and lungs (the 'insensible' loss), in health, this is made good by the intake of fluids and food

The water balance may be upset by inadequate intake or excessive loss, or a combination of the two An excessive loss occurs in febrile states (by sweating) and as a result of vomiting, diarrhœa, accumulation of fluids in the bowel in obstruction, and discharging biliary or intestinal fistulæ In the latter conditions, the 'insensible' loss from the skin and lungs is at first maintained, and the urinary output suffers Later, the interstitial fluids are drawn upon, and ultimately the blood-plasma and the intracellular fluids Depletion of the body fluids by one-quarter is said to be always fatal, in any case, the danger which threatens from loss of water is often greater than that of the disease itself

It should be our aim to anticipate and prevent disturbance of the water balance, or to treat dehydration at the earliest possible moment

To Avoid Potential Dehydration, as in febrile states, e g, septicæmia and osteomyelitis, an additional litre of fluid should be given, to provide for the additional evaporation from the skin The fluid intake, therefore, should be —

Fluid for urine	1500 c c (3 pints)
Fluid for normal vaporization	1000 c c (2 pints)
Fluid for additional vaporization	1000 c c (2 pints)
Total water required	3500 c c. (7 pints)

This intake can generally be ensured by the provision of liberal drinks

To Avoid Potential Dehydration after Operation, it should be borne in mind that only a small proportion of the fluid requirements can be obtained by inhibition, the bulk of the 2½ litres necessary should be given by rectal or subcutaneous infusion, or, if these routes are contra-indicated, by intravenous drip

To Avoid Dehydration in Cases of Vomiting—

a Pyloric stenosis In pyloric stenosis, up to 1500 c c (3 pints) of gastric juice are lost by vomiting or accumulation in the stomach The intake from oral administration of fluid is nil, therefore the fluid requirements are —

Fluid for urine	1500 c.c. (3 pints)
Fluid for vaporization	1000 c c (2 pints)
Fluid to replace gastric juice vomited	1500 c.c. (3 pints)
Total fluid required	4000 c c. (8 pints)

In this case, and in the type following, the fluid has to be administered other than by the mouth, the intravenous route is the most satisfactory

b Loss of all intestinal juices (intestinal obstruction, vomiting, and diarrhœa) The total amount of the intestinal juices is in the neighbourhood of 8 litres To avoid dehydration, therefore, the fluid requirements are —

Fluid for urine	1500 c c	(3 pints)
Fluid for vaporization	1000 c c	(2 pints)
Fluid to replace intestinal juices lost	8000 c.c.	(16 pints)
Total fluid required	10,500 c c	(21 pints)

Treatment of Established Dehydration —From clinical examination, it is not possible to tell how much fluid depletion has occurred A useful clinical rule is *If the patient shows clinical signs of dehydration, he may be assumed to have lost 6 per cent of his body-weight in fluids* This must, therefore, be replaced In a 10-st (60 kilos) patient, a 6 per cent loss of body-weight = 3 6 kilos (equivalent to 3600 c c = 7 pints) In addition to this amount, an additional quantity must be given to cover the daily loss (3000 c.c) The dehydrated 10-st. patient, therefore, requires 6600 c c (13 pints) during his first twenty four hours This is given by intravenous infusion

Salt Loss, and the Nature of the Fluid to be Given Sodium chloride is lost along with the fluid in all dehydrated states, the amount of salt lost in cases of increased perspiration is insignificant The administration of 5–10 g of sodium chloride daily is sufficient under these circumstances to maintain a proper level of blood chloride In pyloric stenosis or high intestinal obstruction, on the other hand, there is considerable loss of chlorides in the vomit, the remaining sodium radicles combine with the carbonic acid of the plasma to form an excess of bicarbonate and an increase in the alkali reserve of the plasma This is the dangerous state of *alkalosis,* and the introduction of sodium chloride is an imperative necessity

To calculate the amount of salt required, two tests are of assistance —

1 If the vomit has been measured, an equal volume of physiological saline should be given intravenously to restore a normal level

2 If the volume of the vomit is not known, the blood-chloride should be measured (normal 575 mg per cent) Then give by injection 55 c c of normal saline per kilo of body-weight for each 100 mg that the plasma chloride is reduced

In a 10-st (60 kilos) individual, 3300 c c. (6 pints, 12 oz) of saline are required for each 100 mg fall in the chlorides

If, as is usual, the degree of dehydration demands a larger quantity of fluid, saline should not be used to supply the remainder An excess of salt leads to water-retention in the tissues, and consesquently to œdema, which will embarrass the lungs and hinder tissue healing One method of overcoming this risk is to substitute 5 per cent glucose solution for the normal saline after the requisite amount of salt has been given A better method is to employ continuously a solution of one part of normal saline to four parts of 5 per cent glucose in distilled water

Acidosis This is the opposite of alkalosis, and comes about through loss of alkali, with lowering of the alkaline bicarbonate reserve, or through the retention of abnormal acid products of fat metabolism

Conditions associated with diarrhœa, or intestinal fistulæ, and low small intestine obstruction, carry off much of the alkali secreted to the upper reaches

of the intestine, which would normally be re absorbed, and the alkali deficit may become critical

The retention of the ketone products (β-oxybutyric acid and aceto acetic acid) of fat metabolism is due to lack of carbohydrate which is essential for the complete combustion of fat In surgical work, this carbohydrate deficiency may result from lowering of the glycogen reserves of the liver, or from lack of exogenous carbohydrate through starvation

The treatment of acidosis is the administration of saline and glucose The saline restores the basic sodium, the excess of chloride being excreted by the kidneys, while the glucose prevents or corrects the formation of acid by products by ensuring the proper combustion of the fats

CHAPTER XVI

DIABETES AND OPERATIONS

By E. Noble Chamberlain

Until the discovery of insulin an operation on a diabetic patient was a nightmare, but whilst it still remains a matter for anxiety and careful thought, its terrors are diminished by the immediate co-operation of the physician and surgeon.

The Operation.—If the operation is one of convenience only—e.g., simple hernia or minor orthopædic measures—the necessity for it must depend very largely on the patient's age and the discomfort he is suffering. A hernia in an old man clearly has a different significance from one in a young man who must earn his living by heavy manual work. In general, operations of convenience should be avoided, but if the patient's activity or comfort is seriously impaired by his condition no hesitation is necessary. With adequate pre-operative and post operative treatment the risks are slight.

Urgent conditions such as perforation of viscera or acute appendicitis require immediate operation and must only be postponed for a period deemed safe by the surgeon. Such postponement as the surgeon considers legitimate may, however, allow the physician a few valuable hours in which to undertake pre-operative treatment of the diabetes.

Similarly in the important decision of when to operate for gangrene, that common and dangerous complication of diabetes, any deferment of surgery must be utilized for control of the diabetes.

Apart from patients whose surgical condition warrants operation irrespective of their diabetes, there are many cases where this disease is aggravated by other complaints—particularly sepsis—which can be dealt with by operation with great benefit to the diabetic state. Chronic sepsis from dental infections, sinus disease, and urinary or alimentary infection furnish examples. In these instances the time chosen for operation will depend upon the response of the diabetes to the usual medical measures, and a reasonable period may be devoted to these without the fear of delay which exists in urgent surgical diseases.

Special mention must also be made of hyperthyroidism, which of itself is often accompanied by hyperglycæmia and glycosuria. These indicate a lowered carbohydrate tolerance resulting from the lessened production of insulin which is caused by the antagonistic effects of the excessive thyroid secretion on the pancreas. Partial thyroidectomy is thus the rational line of treatment. When genuine diabetes is suspected owing to the grade of hyperglycæmia or acidosis, the patient should receive pre-operative treatment as in other operations.

The Anæsthetic.—It must be remembered that all general anæsthetics tend to cause hyperglycæmia. Local and spinal anæsthesia is therefore preferable, but may be supplemented by avertin or evipan without undue risk.

Chloroform should never be used, for even in a healthy subject it may be followed by acidosis, which would be intensified in a diabetic and constitute a serious danger.

Nitrous-oxide–oxygen or ether may be used, but the former is preferable

Pre-operative Treatment—This will depend upon several factors, especially the grade of the diabetes and the severity of the operation

Trivial operations in a mild diabetic need no special measures The patient should merely be carefully standardized as regards diet and insulin and brought to the table with his carbohydrate metabolism as accurately balanced as possible

The same holds good, of course, for more serious operations, though in an emergency time may not permit such an ideal state It then becomes necessary to protect the patient especially against acidosis, and the time before operation should be used to *remove any ketosis* and diminish the chances of this occurring after operation To do this it is important to avoid starvation, vomiting, and severe purgation—all of which tend to precipitate acidosis The patient should continue on the amounts of foodstuffs which have been found previously to be adequate for his diabetic needs, *but the actual constituents of his solid diet* must be replaced by fluids, such as skimmed milk (to remove excess of fat) and fruit juices

In most cases an excess of carbohydrate, e g , 30 g extra glucose, given one hour before operation with 10–20 units of insulin tends to diminish still further the risks of ketosis

When acidosis is pronounced, every hour which the surgeon can allow with safety before operating is vital, as insulin and glucose must be given 2-hourly until ketones disappear from the urine This may be judged by the usual tests Remember that a positive ferric chloride test indicates considerable acidosis, whilst Rothera's nitroprusside test detects much smaller amounts A reasonable dose would be 20 units of insulin and 30 g of glucose 2-hourly until the ketones disappear, but larger doses may be necessary, especially if severe sepsis renders the insulin relatively ineffective

Once the acidosis has disappeared, the insulin may be adjusted to avoid excessive hyperglycæmia A little sugar in the urine, however, is harmless and avoids any risk of hypoglycæmia When time permits, it is probably safer to substitute soluble insulin for zinc protamine insulin, if the patient has been taking this, owing to the uncertain absorption and prolonged effects of the latter preparation Blood sugar examinations when available are most valuable both before and after operation in enabling the dosage of insulin to be accurately adjusted They also avoid the occasional error of mistaking renal glycosuria for true diabetes and endangering the patient by unnecessary use of insulin

Post-operative Treatment—As before operation, the main risk is ketosis, a risk increased by the anæsthetic and operative interference Further, a general anæsthetic may cause vomiting, which again increases the acidosis Herein lies one of the values of local or spinal anæsthesia

The urine must be tested after operation at regular intervals of 2 hours, catheterizing the patient if necessary, and glucose given in similar doses to the pre-operative measures, aiming at keeping a trace of sugar in the urine but no acetone

Often a single dose of 20 units of insulin and 30 g of glucose will accomplish this, but further doses may be necessary When all acidosis has disappeared, the glucose (and correspondingly the insulin) may be gradually reduced until the patient resumes his normal pre-operative diet and quantity of insulin Should vomiting occur, the glucose must be given intravenously or rectally until all acidosis has gone

A final caution is necessary in dealing with cases of serious sepsis The removal of this by operation may result in great improvement in carbohydrate tolerance, rendering the previous dose of insulin too high The signs of hypoglycæmia must therefore not be overlooked

CHAPTER XVII

PRE-OPERATIVE MEDICATION AND BASAL NARCOSIS

By J L HOPKINS

A LARGE variety of drugs are used in the premedication of patients before operation Those most commonly used will be described

Atropine —Atropine inhibits the secretion of saliva and bronchial mucus, which is increased by the use of ether or any other irritating vapour

In chloroform anæsthesia the use of atropine is important, as it reduces the risk of vagal inhibition Primary cardiac failure, which occurs from time to time during the induction stage of chloroform anæsthesia, is believed to be due to vagal inhibition

The usual dose of atropine is gr $\frac{1}{150}$, but this can be increased if necessary to gr $\frac{1}{75}$ Children tolerate atropine well, and infants under six months can be given gr $\frac{1}{200}$ with safety

Morphia and Atropine —This is a popular and safe form of premedication which gives the patient a feeling of well being and slight drowsiness without producing depression of the respiratory centre The usual dose for an adult is morphia gr $\frac{1}{4}$ and atropine gr $\frac{1}{150}$ For aged or debilitated patients, and those between 12 years and 18 years of age, the dose of morphia should be reduced to gr $\frac{1}{6}$ The injection is given half an hour before operation

Morphia and Hyoscine —The combination of morphia and hyoscine produces a greater degree of drowsiness than morphia and atropine, and consequently less general anæsthetic will be required Hyoscine has a similar action to atropine in so far as it reduces the secretion of saliva and bronchial mucus, but its disadvantage is that, especially in combination with morphia, it depresses the activities of the respiratory centre This form of premedication should be given from three-quarters of an hour to one hour before operation. The usual dose is morphia gr $\frac{1}{4}$ and hyoscine gr $\frac{1}{150}$ In young or elderly patients the dose of morphia should be reduced to gr $\frac{1}{6}$

Many prefer to replace the morphia gr $\frac{1}{4}$ by omnopon gr $\frac{1}{3}$ Omnopon is a mixture of all the alkaloids of opium Burroughs Wellcome put up morphia, hyoscine, and atropine combined in a single tabloid known as Hyoscine Compound There are two strengths Compound B contains morphia gr $\frac{1}{4}$, hyoscine gr $\frac{1}{100}$, and atropine gr $\frac{1}{150}$, it is this dosage which is given unless the patient is young, old, or frail, when Compound A, which contains morphia gr $\frac{1}{6}$ and a correspondingly smaller dose of the other substances, is substituted

Morphia and Hyoscine combined with Sodium Pentothal.—This is a combination of drugs which is widely employed to give the patient the advantages of both premedication and basal narcosis

The patient is given a dose of morphia gr $\frac{1}{4}$, and hyoscine gr $\frac{1}{150}$ one hour before operation, and before the induction of general anæsthesia 4 to 5 c c of a 5 per cent solution of sodium pentothal are injected intravenously This is

enough to render the patient unconscious and the subsequent induction of anæsthesia is easier, quicker, and smoother

Sodium pentothal, which has replaced evipan, should be injected more slowly than the latter, also great care should be taken to avoid injecting any of the solution outside the vein, as sloughing of the tissues almost always follows

The tendency at the present time is to replace morphia and hyoscine by omnopon gr $\frac{1}{3}$ and scopolamine gr $\frac{1}{150}$

Paraldehyde—Paraldehyde is a safe and efficient basal narcotic It is given per rectum in a 10 per cent solution of saline The dose is one drachm per stone of body-weight A No 8 rubber catheter, well lubricated, is passed about six to eight inches into the rectum, the patient lying on the left side with the buttocks raised on a pillow The solution is run into the rectum from a funnel attached to the catheter by rubber tubing, and not less than five minutes should be taken to complete the injection When all the solution has gravitated into the bowel, the catheter is clamped A dose of atropine is then given, and the room darkened It is not long before the patient falls into a profound sleep Paraldehyde should be given from three-quarters of an hour to one hour before operation

Avertin (Tri-brom-ethyl alcohol)—This drug is given per rectum in a $2\frac{1}{2}$ per cent solution of distilled water The standard dose for basal anæsthesia is 0 1 g per kilo of body-weight This dose may be varied if necessary to suit different types of patients, elderly people and those with a low basal metabolic rate will only require a dose of 0 09 g per kilo body-weight, while children and patients suffering from hyperthyroidism will tolerate a dose of 0 11 g per kilo The makers supply a table giving the amount of "avertin fluid" and distilled water required for any given weight

When the solution is being prepared it requires vigorous shaking *Great care must be taken to ensure that the temperature of the solution does not rise above 104° F* Overheating may cause the avertin to break down, forming dibrom-acetaldehyde, which causes violent rectal irritation To safeguard against this contingency a few drops of Congo red should be added to the solution immediately before administration The solution should then be bright pink in colour, if the colour changes to blue or even shows a tendency towards blueness, it should be thrown away and a fresh solution made

Avertin is given by means of a catheter, tubing, and funnel in the same way as paraldehyde, and is followed by a hypodermic injection of atropine The solution should be given half an hour before operation, as the maximum concentration of avertin in the blood is reached in that time

Nembutal—This substance belongs to the barbiturate group of drugs, and acts by producing a state of drowsiness Nembutal is given orally in capsules each containing gr $1\frac{1}{2}$ The usual dose is two or three capsules given from one and a half to two hours before operation *On no account should this method of premedication be followed by any other barbiturate such as evipan or sodium pentothal, as the risk of cumulative effects is great*

Nembutal can also be used intravenously by injecting a 10 per cent watery solution at a rate not exceeding 1 c c per minute until the patient loses consciousness

Sodium Soneryl (Butobarbital sodium)—This is another drug of the barbiturate group used to produce basal anæsthesia when given orally It is said to be of lower toxicity than nembutal, and the amnesia produced is neither so marked nor so long as

it is after nembutal Sodium soneryl is given one hour before the induction of a general anæsthetic or an operation under local anæsthesia The drug is put up in capsules containing 0 15 g in each, and the most suitable dose is estimated according to the weight of the patient The following is a table of doses —

ADULTS

Weight	*No of Capsules*
7 to 8½ st	3
8½ to 10½ st	4
10½ to 12½ st	5
12½ st and above	6

CHILDREN

Weight	*No of Capsules*
5 to 6 st	2 to 2½
4 to 5 st	1½ to 2
3 to 4 st	1 to 1½
2 to 3 st	½ to 1
Under 28 lb	½

CHAPTER XVIII

GENERAL ANÆSTHESIA

By H K Ashworth

When administering any anæsthetic, the safety of the patient is always the primary consideration

Other relevant factors are —

1 The provision of adequate muscular relaxation

2 The avoidance, as far as possible, of the use of anæsthetic agents which are either toxic or irritant to the respiratory passages

3 The anæsthetic agents and apparatus at the disposal of the anæsthetist

4 The skill and experience of the anæsthetist

5 The idiosyncrasies or wishes of the patient These will be disclosed at the pre anæsthetic examination, which should always be thorough and should always embrace the following —

a That the patient has consented to the administration of an anæsthetic, or, in the case of a minor, that the written consent of the parent or guardian has been obtained

b That, excepting in cases of grave urgency, the patient has not had a meal recently

c The examination of the urine to exclude or determine the presence of nephritis, diabetes mellitus jaundice, or acidosis

d The examination of the circulatory system, including in particular the blood pressure, if by examination of the pulse it is suspected that there is much deviation from normal

e The examination of the respiratory system

f That the patient has no artificial dentures or loose teeth

g That the patient has had an adequate dose of the required premedication (*see* Chapter XVII), and that sufficient time has elapsed since administration for it to take effect

h The tobacco consumption occupation, and general make up of the patient

Whatever method or anæsthetic agent is used, the anæsthetist has three duties to perform when giving an anæsthetic —

1 Maintenance of adequate surgical anæsthesia for the particular operation to be performed

2 Maintenance of a clear airway

3 Careful observation of the general condition of the patient, as shown by the volume and rate of the pulse, and also by the appearance and temperature

ANÆSTHETIC AGENTS AND METHODS OF THEIR ADMINISTRATION

Nitrous Oxide —If nitrous oxide gas was a more powerful anæsthetic, it is probable that, except in a few special cases, no other anæsthetic would be used, because the gas is non toxic, non irritant to the respiratory passages, and both induction of, and recovery from, anæsthesia are quickly achieved

Unfortunately it is not, by itself, sufficiently powerful to afford muscular relaxation In modern anæsthetic practice the value and power of nitrous oxide gas are often enhanced by the previous administration of a basal narcotic, and in operations in which profound muscular relaxation is required, ether is usually used as an adjuvant

Fig 149—Continuous gas and oxygen' from a Boyle's apparatus fitted with Magill's bag for partial rebreathing

By using ether as an adjuvant only during those periods of the operation for which gas and oxygen provide inadequate relaxation, and not as the main anæsthetic agent, the patient is spared the additional burden of excreting large quantities of a lipoid solvent, the respiratory passages are exposed to less irritation, and after-comfort is increased, especially by the diminution of post-operative vomiting

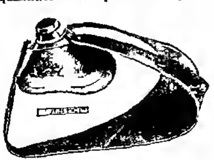


Fig 150.—Face-piece with harness fixing attachment.

The first essential for the successful administration of gas and oxygen with minimal ether is an efficient machine These are of two types, the intermittent and the continuous flow Those in common use in England are the McKesson and the Boyle (Fig 149)

All machines should be used in accordance with the same principles An absolutely airtight fit of face-piece is essential,

and is achieved by Clauson's harness, or some equivalent means of fastening to the face (*Fig* 150)

Induction should be begun by using 100 per cent nitrous oxide at a rate of flow of approximately 6–8 litres per second After about half a minute gradually the face-piece should be approximated to the patient's face As soon as this has been achieved, the rate of flow of nitrous oxide should be reduced until it is sufficient comfortably to fill the breathing bag without causing over-distension It will be found that on the average 4–5 litres per minute, with the expiratory valve fully open, will suffice As soon as anæsthesia, as shown by deep automatic respiration, is obtained, sufficient oxygen must be added to avoid cyanosis A common mistake is to wait until the patient shows signs of cyanosis before adding the oxygen This leads to uneven anæsthesia, for, in order to relieve the cyanosis, it usually results in an excess of oxygen being administered If oxygen is added as soon as respiration becomes automatic, an even plane of anæsthesia is rapidly and smoothly obtained Roughly the amount of oxygen added will depend on how heavily the patient has been premedicated The unpremedicated patient will require about 8–12 per cent of oxygen The heavier the premedication the greater will be the percentage of oxygen required For example, a patient who has previously received a full dose of avertin will often tolerate as much as 25–30 per cent of oxygen added to the nitrous oxide

When it is required to add ether to the gas and oxygen, this should be done some time before the anticipated deeper plane of anæsthesia is required If ether is added suddenly in too great a concentration, the patient is likely to cough, or to hold the breath and strain It is essential, therefore, that the pharynx and larynx should gradually be accustomed to this somewhat irritant vapour Most modern machines have a device whereby the gas and oxygen may be passed over or through the ether and gradually impinged, until they pass through the liquid, in order to obtain the required depth of anæsthesia If during this procedure the patient shows signs of straining, the concentration of ether should be reduced temporarily, and re-strengthened as soon as automatic respiration becomes re-established

Another method of deepening the anæsthesia rapidly is to add 10 per cent CO_2 to the gas-oxygen mixture As soon as the depth of the respiratory excursions has been thus increased, ether can be added without causing straining

It is important to remember, as always when using CO_2, to shut off this dangerous drug when the desired effect has been obtained

When the depth of anæsthesia is satisfactory, usually it is possible to discontinue ether entirely, or at least to maintain deep anæsthesia with minimal additions of ether from time to time

Closed-circuit Machines —In these machines the principle of CO_2 absorption is used

The essential feature is that the patient's expirations pass through a canister containing soda-lime, which absorbs CO_2 (*Fig* 151) The expired gas, freed from the CO_2, is re-breathed A great economy of nitrous oxide gas is thus effected Even greater advantages are the saving of respiratory heat loss, of water vapour loss, and of diffusion of anæsthetic vapour in the theatre atmosphere Furthermore, the patient's respiration being under complete control, by cutting out the absorber the anæsthetist can allow gas to enter the circuit just when he wants it

Any continuous-flow machine may be converted to a closed-circuit machine by interposing the canister between the face-piece and the bag

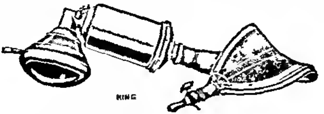


Fig 151 —The Waters CO_2 absorber

The Endotracheal Method (Fig 152) requires special skill in performance, and should not be used unless especially indicated It is particularly valuable · (1) When blood, or other matter, may be expected to enter the respiratory tract (2) For all operations about the head and neck. (3) For upper abdominal operations (4) For thoracic operations

Fig 152 —Anæsthetic trolley with endotracheal apparatus.

The anæsthetic employed is generally gas and oxygen supplemented as required by ether or other stronger agents Any good machine is applicable to the method, the face-piece being replaced by tubing connected to an endotracheal catheter After the patient has been deeply anæsthetized, an endotracheal catheter is passed either by direct vision through a laryngoscope or through the nose, after the method of Magill, who has designed special catheters for the purpose (Figs 153, 154)

The exhibition of CO_2 immediately prior to intubation greatly facilitates the manœuvre by producing maximal abduction of the vocal cords during inspiration The great advantage of this form of anæsthesia is that it abolishes spasm and congestion of the upper air-passages It enables the anæsthetist, by adjustment of the expiratory valve, completely to control intrathoracic pressure, and is

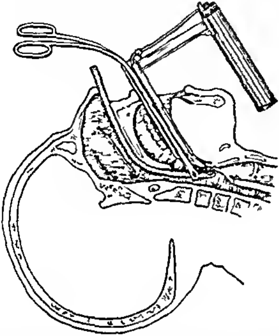


Fig 153 —Intubation. Shows the tube passed through the nose being seized by forceps passed through a laryngoscope for introduction into the larynx

Fig 154 —Nasal catheter

therefore an important part of many thoracic operations *Spraying the nose* and larynx with cocaine beforehand, and lubricating the endotracheal catheter with 10 per cent percaine in lanoline, facilitates the intubation, but the mucosa of the air-passages should not be thus desensitized if there is likely to be any blood in the air-passages in the post anæsthetic period

The processes of intubation are shown in *Figs* 155–158

Other drugs which require an apparatus for their successful and economical use are cyclopropane (C_3H_6) and divinyl ether or vinesthene (C_4H_6O)

Cyclopropane—This is a most potent anæsthetic, stronger even than chloroform, though less toxic It has to be given with large amounts of oxygen, and, on account of its high cost, always by the closed circuit method Induction is started with the bag full of oxygen About 300 c.c. of cyclopropane and 250 c.c of oxygen are added per minute In from one to five minutes quiet surgical anæsthesia is obtained The

flow of cyclopropane is then shut off completely, the oxygen rate being adjusted so that the bag pressure remains constant A little cyclopropane has to be added from time to time to make good losses from leakage or diffusion

The signs of anæsthesia are ill defined, as respiration is rarely altered during induction Cyclopropane should not be used by a novice

Divinyl Ether.—Divinyl ether is another potent anæsthetic of value either as a short anæsthetic by itself or as an adjuvant during the administration of gas

Fig 155 —Correct way to connect the angle piece to the nasal catheter

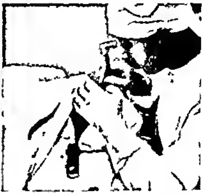


Fig 156 —Insertion of the nasal catheter

Fig 157 —Packing the pharynx.

Fig 158 —Tube in situ connected to the gas and oxygen apparatus.

and oxygen It is so volatile that open methods may not be used, and when given for short anæsthetics it is administered by means of a closed-bag method, a useful apparatus being that devised by Goldman.

Divinyl ether is a stronger anæsthetic than ethyl ether, but is less irritating to the respiratory passages

ANÆSTHETICS WHICH MAY BE ADMINISTERED BY THE OPEN METHOD

Chloroform —Chloroform is the best, but undoubtedly the most dangerous, of all inhalation anæsthetics, consequently it is rightly debarred except in cases where it is clearly indicated Chloroform should always be administered on an open mask covered by a single layer of lint Before administration it is a wise precaution to smear the patient's face with vaseline in order to protect it from the

possibility of a chloroform burn Induction must always be slow, and when anæsthesia is established the old adage of "plenty of chloroform and plenty of air" is a guide to maintenance Uneven, or 'see-saw,' anæsthesia is fraught with danger, sudden increases in the vapour strength must be avoided

Nowadays the main use of chloroform is '*a la reine*' in obstetrics This consists in the exhibition of the minimum amount of chloroform required to produce analgesia as opposed to full surgical anæsthesia Chloroform should never be given to patients suffering from myocardial disease, anæmia, or disturbance of liver function Children are particularly susceptible to delayed chloroform poisoning One great advantage of chloroform is that it is non inflammable and non-explosive

C. E. Mixture, chloroform two parts by bulk, ether three parts, has the same action as, and should be administered in the same way as described in connexion with, chloroform, but larger quantities of the agent are required

A C E Mixture, alcohol one, chloroform two, ether three parts, is a weaker variation of C E mixture, and does not possess any advantages over the latter The principles of administration are the same

Ether.—Although by far the most unpleasant method of receiving an anæsthetic, open ether is the safest anæsthetic which a novice can employ It is literally true that, provided that respiratory arrest is recognized as a signal for withdrawal of the anæsthetic, it is almost impossible to cause the death of a healthy adult with open ether Indeed, the difficulty with open ether is to obtain a sufficient concentration to induce anæsthesia The patient's face should be covered by a pad of gamgee, a gap being cut in it for the nose and mouth Ether is dropped with increasing rapidity on to a Schimmelbusch's mask (*Fig* 159) clothed with six layers of surgical gauze Some arrangement of towel or lint should surround the edge of the mask, in order to prevent the otherwise inevitable waste of heavy ether vapour pouring uselessly down the edges

Induction is slow, and the stage of excitement often prolonged When full surgical anæsthesia is established, respiration is automatic and often stertorous The face, in contrast with the appearance under chloroform, is usually flushed

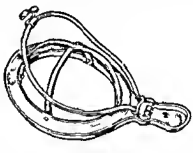


Fig 159—Schimmelbusch's mask.

It should always be remembered that ether is highly inflammable and highly explosive, consequently it should never be administered in the presence of naked lights, diathermy cautery, or open fires If the latter contingency is unavoidable, the fire must be screened by a wet sheet completely touching the floor

Shipway's apparatus (*Fig* 160) is a useful and simple method of maintaining ether anæsthesia in preference to continuing the open method after surgical anæsthesia has been established

Ethyl Chloride.—This is a powerful and volatile agent, chiefly used either for induction by the open method or as a 'single shot' dose in a bag for short minor operations It is supplied in 50-c c tubes The technique of the single-shot method is as follows —

Three to five c c are squirted into a graduated glass container attached by a hollow rubber tube to the bag After the application of the face piece, the contents of the

glass container are volatilized by the warmth from the hand of the anæsthetist, which is raised at the same time so that any remaining liquid in the container is tipped into the bag

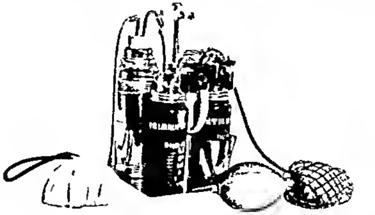
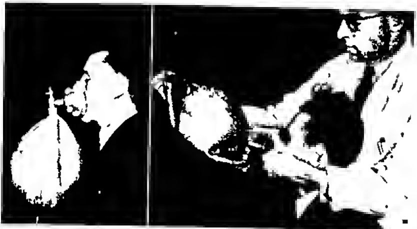


Fig 160—Shipway's apparatus for warmed vapour

Induction (*Figs* 161, A and B) and recovery from anæsthesia are both extremely rapid In spite of these advantages, ethyl chloride is a dangerous anæsthetic It tends



A B

Fig 161—A Ethyl chloride from bag of Clover's inhaler, B, The same—middle of administration

to produce muscular spasm, and unless an absolutely clear airway is maintained, respiratory obstruction is apt rapidly to occur, which unless promptly relieved is quickly followed by circulatory failure

MAINTENANCE OF ADEQUATE ANÆSTHESIA FOR THE PARTICULAR OPERATION IN PROGRESS

Respiration should always be the main guide to depth of anæsthesia, eye signs should be subsidiary and used only when in doubt The less the eye

reflexes are examined, the less will be the chance of causing conjunctivitis Moreover, if a narcotic premedication has been employed, eye signs tend to be unreliable

Alteration in respiratory rhythm or volume during surgical anæsthesia signifies that the depth of anæsthesia is getting either lighter or deeper Whatever anæsthetic agent is employed, if it is pushed to the point of depression of the respiratory centre, the effect on respiration is always the same, i e, respiration is diminished in all its phases—rate, volume, and rhythm

Care of the Eyes—The eyes of the patient must be kept closed during anæsthesia, and should be examined as infrequently as possible Above all, every care must be taken to avoid liquid or vapour coming into contact with them during administration by open methods After open anæsthesia, two or three drops of castor oil should be placed in each conjunctival sac This should not be done until the end of the administration, because ether is soluble in oil

Salivation—All anæsthetics cause some degree of salivation and of mucous secretion in the air passages, ether being by far the worst offender in this respect General anæsthesia, except for extremely short administrations, should therefore be preceded by an effective dose of atropine, unless a premedicant containing hyoscine has been given previously Children are prone to copious salivary secretion, and on account of their smaller air passages and less powerful respiration, respiratory obstruction is liable to occur from excessive mucus, hence the necessity for efficient pre-operative atropine in these subjects The dosage of atropine given forty minutes before operation should be as follows —

0–3 months	Nil
3 months 1 year	1–200 gr
1–2 years	1–150 gr
3–5 years	1–120 gr
5–12 years	1–100 gr
12 years or over	1–60 gr

Maintenance of a Clear Airway—It is safe to state that 90 per cent of the complications and anxieties of anæsthesia arise directly or indirectly from partial or complete obstruction of the airway A prime duty of the anæsthetist is to maintain an absolutely clear airway Whatever its cause, obstruction of the airway calls for prompt and energetic relief Partial obstruction is a more insidious danger because it is too often allowed to persist uncorrected It has two inherent dangers First, it may lead to a false deduction as to depth of anæsthesia Secondly, it may lead to a partial but slowly cumulative anoxia which may suddenly and without warning endanger the life of the patient

Obstruction of the airway, whatever the cause, is complicated by spasm of the masseters, causing tight clenching of the jaws The simplest and most effective way of opening the mouth in such circumstances is to thrust a pair of blunt pointed surgical scissors under the upper incisor teeth This will enable either the insertion of a gag or the gripping and pulling forward of the tongue, without damaging the patient's teeth

The commonest cause of obstruction of the airway is due to the tongue falling back on to the posterior pharyngeal wall during anæsthesia This may be prevented by holding the lower jaw forward, or by the insertion of an artificial airway, or by a combination of both Waters' metal airway (*Fig* 162) is most satisfactory, for it is well tolerated even under light anæsthesia, and may therefore be inserted early, it causes no retching when inserted in the conscious patient, as may be verified by a personal trial

Careful Observation of the Condition of the Patient, as shown by the Volume and Rate of the Pulse, and also by the Appearance and Temperature.—It is the duty of the anæsthetist constantly to observe these factors in order that he may be in a position to assess the general condition of the patient, and the degree of shock which may develop during any operative procedure. If anti-shock measures become necessary, he should report the fact to the surgeon and supervise their prompt institution. In this respect it cannot be stressed too strongly that it is better unnecessarily to set up many intravenous drip saline infusions than to leave one until it is too late for it to be effective.

Fig 162.—Waters metal airway

Complications during Anæsthesia.—Apart from obstruction of the airway, the commonest complication is overdosage, as shown by failing respiration. If respiration fails owing to too deep anæsthesia, the following measures should be instituted immediately:—

1. Withdraw the anæsthetic.
2. Lower the head.
3. Grasp the tongue with tongue forceps, draw it forward, and keep it held forward by an assistant.
4. Direct a gentle stream of pure oxygen (not oxygen and CO_2) at the open mouth of the patient.
5. Promote the resumption of respiration and also the excretion of the anæsthetic by performing artificial respiration.

If, in spite of these measures, circulatory failure supervenes, the measures for dealing with it are given in Chapter II.

Care of the Patient during Transit, etc., under Anæsthesia.—It is the duty of the anæsthetist to supervise the transit of the anæsthetized patient to the operating theatre, and his transfer from the trolley to the table, paying particular attention to such details as the removal of hot-water bottles from direct contact with the skin of the patient, and his posture on the operating table. During operations in the dorsal decubitus, the arms should be straight down by the patient's side, and firmly fastened to the table. If they are placed across the chest they cause a slight, but undoubted, interference with free chest movement during respiration. When the patient leaves the operating theatre, the anæsthetist should give clear instruction on any factors within his province which may require subsequent attention either during transit or after the patient has returned to the ward.

CHAPTER XIX

INTRAVENOUS ANÆSTHESIA

By W I B Stringer

In recent years intravenous anæsthesia has widely increased in popularity This is largely due to the comparative safety, ease of administration, and greater depth of anæsthesia produced by recently discovered drugs of the barbiturate group The most important members of this group are sodium evipan and sodium pentothal The latter produces more profound anæsthesia and the induction is smoother It is, however, much more likely to cause respiratory depression, and should the solution be injected into the tissues around the vein, severe local reaction and even ulceration will take place The indications, premedication, necessary equipment, etc , are the same for both these useful drugs Because of its smoother induction and deeper anæsthesia pentothal is becoming increasingly popular The administration of evipan is described below and the variations necessary in pentothal technique are noted subsequently

Indications.—It should be remembered that often several hours elapse before a return to consciousness following evipan anæsthesia With minimal doses—just enough to produce sleep—it can be used in the Out-patient Department if the patient is allowed one or two hours to recover Occasionally even these patients will have to be admitted With full doses, patients should be admitted to hospital for twelve hours

Although continuous evipan can be used for prolonged operations, considerable experience is required for its administration in these cases For general purposes it is inadvisable to employ evipan for surgical procedures lasting more than twenty minutes

The following list gives some of the more important indications for the use of evipan —

1 Short operations, e g , opening abscesses, reducing dislocations, and carrying out minor amputations

2 Short operations on the face and neck, e g , abscesses, dental extractions

3 As premedication to some other anæsthetic (This is especially valuable with a very nervous patient)

4 Combined with local anæsthesia Evipan is useful in emergency abdominal surgery—e g , perforated gastric ulcer—when local anæsthesia has been employed and when a continuous intravenous infusion has been commenced The drug is administered through the delivery tube of the apparatus with the saline turned to a steady flow Evipan, combined with local anæsthesia, is particularly useful in restless elderly patients The absence of an inhalation anæsthetic in these cases helps to prevent post-operative pulmonary complications

5 *For special clinical examinations, e g , cystoscopy,* bronchoscopy *In these* cases evipan is usually combined with local anæsthesia

6 War wounds and burns Intravenous anæsthesia—alone or combined with other anæsthetics—has been found to be very useful in these cases It has been shown that shock is considerably lessened especially when the patient is to be transferred by ambulance shortly after operation

Contra-Indications —

1 Liver disease or impaired liver function As evipan is metabolized in the liver, any advanced hepatic disease or the presence of jaundice is a definite contra-indication for its use

2 Markedly decreased kidney function Kidney disease is not considered a contra indication However, when there is a minimal amount of kidney tissue function, such as in cases of impending anuria, it is unwise to administer evipan This is also true in very toxic patients, who would take a long time to eliminate the drug

3 Hypotension As this drug tends to lower the blood pressure still more, it is contra indicated in cases of low blood-pressure

4 In young children Firstly, because of the difficulty of giving an intravenous injection, and secondly, because of the difficulty of maintaining an airway in small air passages

Premedication—While premedication is not absolutely essential, it has the following advantages (1) It lengthens the anæsthesia by slowing up kidney excretion, (2) It helps to calm restless patients, (3) It reduces the incidence of muscle twitchings which occasionally occur during induction

A hypodermic injection of morphia, gr $\frac{1}{4}$, or omnopon, gr $\frac{1}{3}$, should be given one hour pre-operatively In the author's experience, cases that have given cause for worry have been those which have also received an injection of hyoscine, and for this reason omnopon only is advised Other barbiturates, e g, nembutal, are not advised as pre-medication This is especially true when drugs such as medinal have been given over long periods for sleeplessness, etc Respiratory depression may be particularly severe in these cases

It is as important in intravenous, as in inhalation anæsthesia, that the stomach should be empty

Equipment.—The following equipment is needed for the administration of evipan anæsthesia —

2 glass ampoules of sodium evipan
2 glass ampoules of distilled water
File to open ampoules
10-c c Record syringe with eccentric nipple
1 large intravenous needle (for mixing solution)
1 small short bevelled intravenous needle about 3 5 cm long
Sterile towels and swabs
Iodine or spirit
Rubber tubing and artery forceps, for use as a tourniquet.
Respiratory and cardiac stimulants —
a Coramine, dose 1–5 c c
b Picrotoxin, dose 2–5 c c

The Preparation of the Solution—Evipan is supplied in a glass ampoule containing 1 g of white powder, to which distilled water from another ampoule is added This must be freshly prepared at the time of the operation, as deterioration commences about two hours after the solution has been prepared Whether the syringe and needles have been sterilized by boiling or in spirit, they should be thoroughly washed out in distilled water before use

The solution is prepared by aspirating the distilled water and injecting it into the ampoule containing the powder The powder is thoroughly dissolved by aspirating and reinjecting the solution A large intravenous needle is of great advantage in mixing the solution, and will be long enough to reach the bottom of the ampoule and prevent the spilling of the liquid

Technique of Administration—It is wise before deciding to give evipan anæsthesia to ascertain whether the patient has veins which can be used for intravenous purposes The median basilic vein in the antecubital fossa is usually

chosen as the most convenient, but any superficial vein may be used A varicose vein is unsuitable because the blood is stagnant and absorption will be slow It will be found that skill in evipan anæsthesia depends much on experience in intravenous work Edwards's vein seeker (*see* p 73) is a very great help, not only to the beginner, but also to all anæsthetists, in the case of small or inaccessible veins

Because of the resultant fall in blood pressure it is wise to have the patient in the recumbent position Gross movement of the patient—e g, to the lithotomy position—after the introduction of the needle into the vein should be avoided, as it may cause displacement of the needle

The arm selected is placed on an arm rest or table, and the skin sterilized with spirit The tourniquet (a piece of rubber tubing and an artery forceps is satisfactory and simple) is applied above the elbow by an assistant, who then holds the limb in position The needle is inserted well into the lumen of the vein, so that any slight movement will not cause its displacement *Blood is* aspirated to determine whether the needle is in position The anæsthetist then instructs the assistant to release the tourniquet The patient is told to count slowly About 2 c c are injected in the first *fifteen* seconds A pause for a few seconds is then advisable, so that the anæsthetist may watch the patient's reaction to the drug, and then the injection is continued at the same rate Usually 3 c c is the amount required to induce sleep, which is heralded by cessation of counting, dropping of the jaw, and sometimes by a deep yawn or snore *For short operations one-half as much again is injected*, for longer operations the same amount This quantity can be injected somewhat more quickly The jaw should be supported, and a patent airway ensured Individual tolerance to this anæsthetic varies greatly We have seen good anæsthesia from as little as *1 5 c c*, and almost no effect produced with as much as 20 c.c For this reasoo it is most imperative that the primary reaction to the injection should be carefully noted

For longer operations it is convenient to keep the needle in the vein, and to administer small amounts as required

Reactions and Overdosage—Jactitations of the limbs and twitching of the muscles may occur during the administration of evipan They are not often seen, however, when a preliminary dose of omnopon has been given These reactions should be no cause for worry, for they pass off in a few seconds as anæsthesia deepens

Death from evipan anæsthesia is extremely rare Overdosage should seldom occur if the anæsthetic is properly administered The main complication is respiratory depression If this occurs, make sure that the airway is clear Administer 5 per cent carbon-dioxide mixture in oxygen under slight pressure Give 3 c c of coramine hypodermically, or if necessary, intravenously *Intravenous* picrotoxin—2–5 c c of 0 3 per cent solution—is a useful drug in this, as in other cases of barbiturate poisoning (*See also* p 12)

Post-operative complications are fortunately rare Mental confusion is common during the period of recovery A hypodermic injection of omnopon will be found to have a quieting effect in these cases Hiccup may occur post-operatively, especially when the drug is given too rapidly It is treated by the administration of CO_2 by the direct method Too rapid administration may also give rise to severe headaches, dizziness, and double vision These can be avoided by carefully adhering to the prescribed technique

Differences in the Technique of Sodium Pentothal Administration.— Because of the dangers associated with the paravenous injection of pentothal, special care in administration is to be advised, 1 g of the powder is dissolved in 20 c c of sterile water instead of 10 c c as is advised with evipan This more dilute solution is less likely to cause local reaction when the solution is inadvertently injected outside the vein

The dosage of the weaker 5 per cent solution is, of course, twice that recommended for evipan Because of the danger of respiratory depression sodium pentothal is administered at one half the rate advised above for evipan Thus the first 4 c c is given in *thirty* seconds This is followed by a pause of another thirty seconds before further injections are made

The chief advantages of pentothal over evipan are smoother induction, less marked fall in blood-pressure, and the rarity of twitching and jactitations The tendency to respiratory depression is not serious when the drug is administered slowly in a fully equipped operating theatre

CHAPTER XX

ASSISTING AT OPERATIONS

By NORMAN M MATHESON

As in so many other technical matters in which dexterity comes from repetition, practice solves most of the *early difficulties* *Let familiarity with the tools come first* Master every appliance on the operating table and handle over and over again all commonly used instruments , a hæmostat carried in the coat pocket can in a day or two, be opened and closed with the left hand as expeditiously as with the right Some instruments, e g , tissue forceps, are almost habitually used in pairs, so when one is asked for the second should be ready Gentleness in all actions is of the utmost importance, and should be cultivated from the very commencement of one's first surgical appointment—likewise tidiness, for there is a proper place for most instruments A few minutes' pre-operative rehearsal is never superfluous, and a worthy assistant needs no prompting as to the virtues of punctuality Anticipation of an individual surgeon's wants, so highly desirable for the quiet progress of an operation, can as a rule be soon attained by observation of the personal conventions Judiciously restrain all undue haste and *restrict* any *unwarranted movement* When possible, an assistant with a cold—especially in the coryzal stage—should seek a deputy for theatre work.

Preliminary Preparation —Make a practice of wearing a cap and mask on every occasion one enters the theatre, and always change to the boots provided in the ante room

From the radiographs, select the pertinent ones and place the most suitable in the viewing box If the suction apparatus is to be used, see that it is in readiness and in working order Test all electrically illuminated instruments In all cases of intestinal obstruction with vomiting, aspirate the gastric contents immediately prior to the induction of anæsthesia

The Mask —This should consist of several layers of gauze and must be made to cover the nose as well as the mouth A sheet of cellophane (which can be easily obtained and readily sterilized by boiling) included between the layers *of the gauze* (*Fig* 163) provides a satisfactory means of preventing expired air from reaching the wound It is particularly useful on those occasions when the face is to be in close proximity to the part When working in hot weather perspiration from the brow may be distressing even in those usually unaffected by this troublesome inconvenience Two or three layers of gauze wrapped transversely around the head before donning cap and mask mitigate the possibility of soiling the wound from drops of perspiration

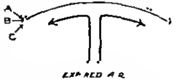


Fig 163 —Mask to prevent expired air from contaminating the wound. Cellophane (B) is introduced between layers of gauze (A C)

Preparation of the Hands —The hands and forearms are to be thoroughly scrubbed with ether soap in freely flowing hot water , the sterile brush should *be firm,* but *not too hard.*

In this important preliminary a definite ritual is followed, commencing at the fingers and finishing at least at the level of the elbows No region is disregarded, but the finger tips, the spaces between the fingers, and the ulnar borders of the forearms and hands receive special consideration Systematic scrubbing is of as much consequence as the time expended, for haphazard washing must always be ineffective—even when continued longer than the generally allotted time of five minutes

Following this initial cleansing, the hands and arms are soaked for two minutes *in a solution of biniodide of mercury in spirit (1–10 000), and then dried with a* sterile towel

Precautions —

1 When drying, the hands must be raised by flexion of the elbows to prevent moisture from running to the cleansed forearms and hands from proximal parts of doubtful sterility

2 Take care to see that the mackintosh worn while scrubbing is changed if splashed with water, otherwise the gown, which is to be donned soon afterwards, becomes saturated from the underlying mackintosh thereby imperilling the sterility of the operative field

Fig 164—Showing the powder bag and the method of holding the glove

Fig 165—The final adjustment in putting on gloves—turning back the cuff so as to maintain sterility of the outer surface

Fig 166—Once the sterile gloves have been put on keep the elbows flexed.

Gloves.—These should be carefully selected, and proved to be free from punctures, a tight glove soon becomes uncomfortable, and a loosely fitting one impedes fine work. Before attempting to put on gloves, see that the hands are well dried and evenly powdered. If each pair of gloves is sterilized in a separate bag, this can conveniently be employed to draw the glove on the hand. If not placed in separate bags, have the cuffs turned down before sterilization. To avoid all contact between the skin and the outside of the gloves, partially draw the first glove on the hand by grasping its inner surface at the rim of the turned-down area (*Fig.* 164) and touching that surface alone. Then similarly draw on the second glove. Make the final important adjustment of the cuffs in the manner shown in *Fig.* 165, thereby ensuring that the outer surface of the glove remains perfectly sterile. Cotton gloves, worn over the rubber ones, give useful protection and a firmer grip when dealing with rough irregular fragments of bone.

When once gloved, at all times hold the arms so that the hands are above the level of the waist, for dependent hands are most likely to make contact with unsterile objects (*Fig.* 166).

Gowns.—Shortness of the sleeves is a not uncommon fault, and although all is well when the operation commences, sooner or later an area of the forearm becomes exposed, often unbeknown to the wearer. Stockinette sleeves are useful to maintain the sterile junction between gown and glove. Remove the gown from its container with care, it is very easy for a small portion of the contents to be dragged out and become contaminated on the drum wall or remain protruding after the lid is closed. When donning a gown, insist that the back is always as completely covered as the front. The unseen, unprotected, part will almost certainly come in contact with a sterile table when the assistant turns to rinse his hands, as he must during the course of an operation of any duration.

Position of the Patient.—This important prelude well repays careful consideration, but as the position of the patient varies so much according to the requirements of the specified operation, no attempt is made to give comprehensive instructions.

Sandbags should always be in readiness, and a preliminary trial of the adjustable bridge of the operating table is time well spent. It is advisable to arrange the shoulder supports *before* all operations at which the Trendelenburg position is at all likely and in most cases where high spinal anæsthesia is employed, their use may be hastily required.

Whereas the postural nerve palsies are well known and usually sufficiently guarded against, it must be emphasized that the possibility of pressure gangrene of the limbs demands the same meticulous attention. Under no circumstance is the whole hand to bear the weight of a recumbent patient. If the arms are to be by the side, see that the *fingers are fully extended and never flexed*. The thumbs—and no more than the thumbs—should lie beneath the buttocks. Whenever a lateral attitude is adopted, ascertain that the peripheral pulse of the dependent limb is not impaired.

Finally, when the correct position is assumed have the overhead light so adjusted as to illuminate the operative area really well.

Preparation of the Part.—Apply all lotions with swabs held on long forceps, and prepare an area well wide of the site of the proposed incision. Stand well away from the patient and pay special attention to regions such as skin creases, which are known to harbour infection. Commencing peripherally, proceed towards the umbilicus, which should be the last area to be painted (*Fig.* 167). Avoid excess of lotion. On no account should this be allowed to flow over the skin and saturate dependent parts of the patient. It should be remembered

that commonly used antiseptics, such as tincture of iodine, are very irritating if copiously applied to certain tissues, e g , the skin of the scrotum All parts not immediately concerned with the operation are covered with sterile mackintoshes and thereafter draped with sterile towels, which are retained in position by skin

Fig 167 —Preparation of the abdominal wall With a gauze swab soaked in tincture of iodine and held with long forceps a wide area has been prepared, the umbilicus being the last part to receive attention.

clips These clips, when correctly placed, lie evenly on the part Applied reversely, the upturned end soon becomes entangled in a suture or ligature

Position of Assistant —Posture plays a definite role when assisting at long operations Stand well above the wound—on a stool if necessary—with the arms hanging loosely from the shoulders To work with the arm even slightly elevated becomes fatiguing as time goes on—a fact well contrasted with the comfort with which one can assist at a hysterectomy when the patient is in the full Trendelenburg position.

The Midline of the Wound —Remember that the midline of a wound is essentially the surgeon's province, therefore one must endeavour to keep that region clear by retracting laterally, by holding sutures laterally, and by arranging hæmostats so that they lie naturally away from the midline Keep the hands from the wound when not in use in that sphere and do not obstruct the surgeon's view by leaning too far forwards

Ligatures and Sutures —Catgut, as commonly used, is supplied in sealed glass containers, the glass is strong, but to facilitate opening the manufacturers place a score mark on the tube On either side of this the thumbs are placed and the tube is bent towards one Haphazard struggling to break the ampoule, generally time-consuming and often unsuccessful, is not without danger, for the fingers can be severely injured by the sharp edges of the resulting fragments A safe and satisfactory method is to wrap the container in gauze

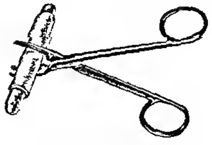


Fig 168 —Breaking ligature container with special forceps

to collect broken pieces of glass, and to get an assistant to crush it in the jaws of a pair of Cheatle's forceps or with the specially designed ligature tube breaker of Denis Browne (*Fig* 168)

It is desirable to develop the habit of cutting all ligatures with blunt nosed scissors, until proficiency is attained, support the blades on the forefinger of the left hand (*Fig* 169) Occasionally a ligature, cut too long, needs further trimming Always remove the detached fragments with forceps, otherwise there is nothing to be gained by cutting them off

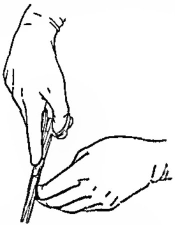


Fig 169—Cutting ligatures Blades of scissors supported by fingers of the left hand

Fig 170—Simple knot for attaching suture to needle

For the beginner skin scratches at right angles to the wound are well worth while as a guide to the accurate insertion of stitches Suturing may be provoking at first, the short end of the catgut slipping from the eye of the needle after every few stitches, until experience is acquired attach the suture to the needle by means of a simple loop as shown in *Fig* 170

Owing to the natural tendency for silkworm gut to curl, apply forceps to all such sutures, and see that the forceps are attached really near the ends of the strands (*Fig* 171) If applied towards the wound, the constriction remaining

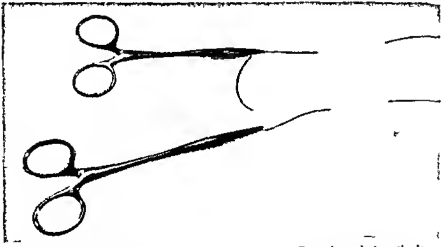


Fig 171—Applying hæmostats to silkworm-gut sutures Correctly applied in the lower figure If attached as shown in the upper constriction remaining after removal leaves a weakened area apt to break as the knot is tied.

after the forceps are removed is a weakened area very prone to break when the knot is tied Arrange all through and through sutures in parallel rows, so that there is no confusion when the strands are ligated

Knots—Seldom is it the assistant's task to employ elaborate knots The reliable reef (*Fig* 172) and the equally simple surgeon's knot (*Fig* 173) are all

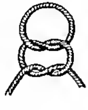


Fig 172—Reef knot.

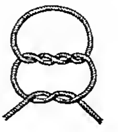


Fig 173—Surgeon's knot.

that are usually demanded of him, such knots should be accurately placed and securely tied with both hands There must be no jerking A steady even pull until the loop is taut is all that is ever necessary, and particularly is this so in applying the first turn of a knot When tying, do not incline over the wound, thereby obstructing the operator's view, and, having tied, withdraw the hand which holds the ligature somewhat to one side so as to allow a clear field for the surgeon to cut With the present interest in the traumatic surgery of the limbs the clove hitch has once more come into prominence The great advantage of this simple knot is that it becomes firmer the more it is pulled upon yet it can be released in a moment Moreover, it has no tendency to slip *Fig* 174 shows the essential features of the knot

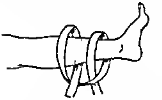


Fig 174—The essential features of the clove-hitch knot.

Hæmostasis—The correct and effective application of artery forceps constitutes one of the main duties of an assistant He must be familiar with both the straight and the curved variety of hæmostat, and be able to take either from its allotted place without the slightest hesitation

Apply the point of the hæmostat gently to the bleeding vessel and include only the minimum of tissue within its grasp Elevate the handle when the ligature is being placed, and depress it really well when the knot is to be tied Release slowly and evenly—usually after the first hitch of the knot is secure—and then return the hæmostat to its proper place Otherwise, forceps soon collect around the wound and hamper an orderly technique When two hæmostats are applied to the one bleeding area, place the points together and keep them together when the handles are depressed for the tying of the knot

Threading Needles—To thread a needle quickly and neatly is an acquisition which well repays the house surgeon's attention Frayed ends and a discrepancy between the size of the eye and the width of the suture are obvious sources of trouble Choose a needle with an eye too large rather than too small and remove frayed ends with an oblique deliberate cut with sharp scissors Secure the shaft of the needle firmly between fingers and thumb of the right hand Holding the strand in the left hand and well away from its extremity, pass the eye of the

needle around the end of the steadied strand (*Fig* 175) Approximation of the finger tips, as shown in the illustration, aids steadiness of movements

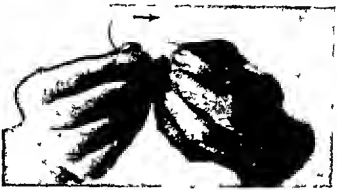


Fig 175—Threading needle on suture

Swabbing of Wound—Small swabs are better not used, and sodden ones are to be discarded early To be efficient the mopping must be directed to the site of the severed vessel The pressure should be firm, but only momentarily applied Although there should be no rubbing of the wound, an occasional light stroke along the skin margin is permitted to deal with superficial oozing In small or deep wounds, make a practice of using swabs held with dressing forceps

Retracting—Retractors are to be held with a firm but gentle pull, upwards as well as outwards, and from the beginning they should be grasped so that there is no overlapping of the arms Changing of the grip at a critical moment should not be necessary Remember that there is an insidious tendency to relax the hold as the operation proceeds, and that too much depression of the handle is apt to cause an abrupt unanticipated jolting of the blade from the wound Distinct care is to be exercised when retracting in the neighbourhood of vessels, for the thin walls of veins can be damaged with surprising ease

Dressings—Supervise the application of dressings, paying particular attention to those of the neck, axilla, and inguino-scrotal region When possible discard gloves before handling cotton wool and adhesive plaster If a tourniquet has been used, see that it has been released when not required, in every case in which hæmorrhage is likely to recur from wounds of the limbs, arrange for the tourniquet to be conveyed with the patient during his transit to the ward

Pricked Finger—Should an assistant have the misfortune to prick or otherwise abrade his skin, however slightly, during the course of an operation, the surgeon is to be notified at once Relieved of his duties, the assistant immediately removes the gloves, and prompt strong sucking of the finger is probably the most effective initial treatment Should the accident occur in an infected wound, a prophylactic course of chemotherapy is a wise precaution The first does should be three tablets of sulphanilamide dissolved in citric acid to promote absorption Commencing two hours later and continuing at four hourly intervals one un crushed tablet should be taken for four days

CHAPTER XXI

REPAIR OF OPERATIVE INCISIONS

By N M Matheson

In the closure of operative wounds divided structures must be accurately readjusted, layer by layer, and with the obliteration of dead spaces and the avoidance of all trauma. Close, but not tight, coaptation of skin margins is essential if a neat scar is to be secured.

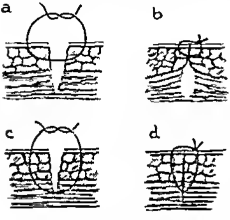


Fig 176—The interrupted deep suture. *a* and *b* improperly placed leaving a cavity when tied. *c* and *d* correctly placed closing wound without cavity. (*After Hertzler and Chesky*)

One of the greatest causes of failure of a clean wound to heal by first intention is imperfect hæmostasis. All bleeding points must be ligated. Should there be oozing from the cut surface, the wound must be drained.

As a rule, *buried* (catgut) and *superficial* (silkworm gut or thread) sutures are used, and in many instances deeply placed non absorbable *tension* stitches are employed to relieve the stress which tends to separate wound margins. *Interrupted* rather than *continuous* stitches are inserted whenever much strain is likely to be imposed upon the suture line. Simple methods of suturing are just as effective as the more elaborate refinements.

Needles.—There are many different kinds of needle, and most surgeons have their special preference. Straight cutting needles are employed for the skin and large curved cutting needles for the insertion of deep sutures and for sewing fascia.

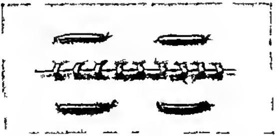


Fig 177.—Closure of wound. Deep silkworm-gut sutures supported by rubber tubing threaded parallel to the incision. Michel clips for skin approximation.

Deep Tension Sutures (*Fig* 176).—Silkworm gut is employed. There is always a certain amount of tension on these stitches, unless precautions are taken they tend to cut through the more superficial structures. To shield

the skin many contrivances have been devised, perhaps the most common being to pass short lengths of rubber tubing along the protruding portions of the sutures (*Fig* 177) When much tension exists Emesay suture buttons are particularly satisfactory, especially if small squares of vaseline lint are placed beneath them to prevent them causing pressure necrosis of the skin (*Fig* 178)

In the centre of these buttons is a special nipple which can be firmly squeezed around the stitch and so take the stress A button is attached to one end of the suture before it is passed Having inserted the stitch, the loose end is pulled taut, and a second button is slipped on and fixed in position by crushing the projection with the special forceps

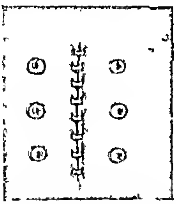


Fig 178.—Relief of tension on deep sutures by means of the Emesay suture button.

Interrupted Sutures—Each reef knot is so applied that the twist lies at one side and not over the line of the wound (*Fig* 179) The skin surfaces should be approximated exactly, without too much tension It is better that the edges

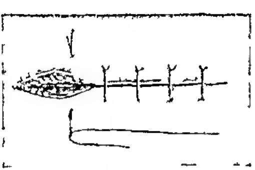


Fig 179—The interrupted skin suture

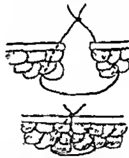


Fig 180—Interrupted suture for accurate approximation of skin margins Note the points of entrance and exit right at the margin of the incision. (*After T I Kilner*)

should be a little everted No strict rule can be laid down as to the depth at which superficial sutures should be passed, but it is often advisable to place them deep enough to arrest oozing from the wound edges Silkworm gut, and occasionally horsehair, are the materials chiefly employed

To secure accurate apposition and yet avoid scarring by transverse stitches a minor modification of the interrupted suture is particularly useful in the repair of incisions on the face or neck. The needle enters at one skin margin, takes a full bite of the deeper tissues, and emerges close to the opposite skin margin (*Fig* 180)

METAL CLIPS—Another way of bringing the edges of the wound together is by means of *Michel's clips* (*Fig* 181) Michel's clips are held over the wound and at right

angles to it by means of a special pair of forceps and are then pressed down on to its edges, while at the same time the blades of the forceps are forced together, causing the pliable bridge to bend in the middle The clips thus bring the edges of the wound into

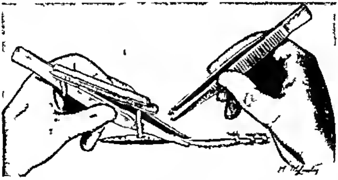


Fig 181.—Michel's clips

apposition with slight eversion They should not be applied too tightly, for excessive pressure at the point of insertion favours skin necrosis, it is a good practice to leave a small interval between the wound margin and the bend of the clip to facilitate removal They are removed, usually on the fourth or fifth day, with special forceps

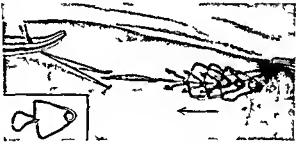


Fig 182 —Method of closing a wound with van Herff's clips. (Inset —One of the clips)

Kifa Clips are the same in principle, but are provided with flanges to facilitate removal.

Van Herff's serrefines (Fig 182) are valuable for suturing small wounds, especially about the face Their fine points leave little scarring

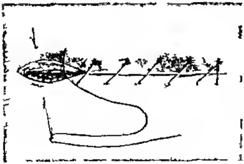


Fig 183 —The simple continuous suture

Continuous Suture — The simple continuous suture (*Fig* 183) produces more perfect hæmostasis from the edges than does the interrupted, but has the disadvantage that, should infection supervene, it is impossible to liberate pent up infection without sacrificing the whole length

The Subcuticular Suture (*Fig* 184) —This type of continuous suture is employed when a linear scar is desirable Having closed the

deeper parts of the wound, a long strand of fine catgut is threaded on a narrow needle and the end tied in a rather large knot From the skin at one extremity of the incision the needle passes into the subcuticular tissue and the suture proceeds parallel to and immediately beneath the surface, first on one side and then

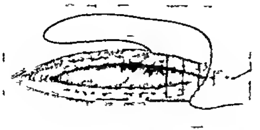


Fig 184—The subcuticular suture

on the other, until the opposite angle of the wound is reached Here the needle again passes through the skin and the suture is conveniently concluded with the aid of an Emesay button

DRAINAGE OF WOUNDS

While there are many advantages in being able to dispense with a drainage tube, provision must be made for the escape of exudates except in the case of wounds which are small, or adjudged to be perfectly healthy, and when hæmorrhage is known to be controlled perfectly

1. Superficial Wounds—

Rubber Tissue (*Fig* 185, *a*)—This is used to drain superficial structures It can be obtained from an old surgical glove and fashioned to meet the demands of the particular case The selected length, insinuated into the subcutaneous space by means of a pair of sinus forceps, drains to the exterior at a convenient place in the wound, usually at one angle

Corrugated Rubber (*Fig* 185, *b*, *e*)—When thick discharge is anticipated, *corrugated* rubber is preferred, serrated if necessary to prevent its slipping from the wound If, as Professor Learmonth suggests, one row of serrations is cut to point one way and the other row to point in the opposite direction, the corrugated strip can be prevented from moving either in or out of the wound

Whenever small rubber drains are inserted *before* a wound is closed, care must be taken that they are not penetrated by a deep suture

2 Deep Wounds—As the whole object of a drain is to prevent fluid remaining within a wound, no exception can be made to the rule that all surgical cavities are to be *drained from the bottom* The place of exit for the drain should be the most dependent part of the wound If necessary, a stab incision is made to achieve this object

Rubber Tubing (*Fig* 185 *c*, *d*, *f*)—Rubber tubing conforms to the shape of the wound and is sufficiently firm not to kink The end should be bevelled to facilitate introduction, and the walls fenestrated or split lengthwise The perforations of all abdominal drains must be small to prevent intestine or omentum prolapsing through the openings

Size of the tube Since all drains act as foreign bodies, the tube should be as small as will freely carry off the discharges There must, however, be no curtailment in length, for it should be able to reach to the depths of the cavity

Introduction of tubes A tube may be directly placed in the required position before the wound is closed or inserted after the suturing is complete Thin forceps guide the tube to its correct position Angulation is to be meticulously avoided, and whenever possible a drain should not be allowed to rest in direct contact with large vessels

Fixation In order that a tube may not slip in and out, it should be retained in position by means of an anchoring suture which attaches it to the skin In

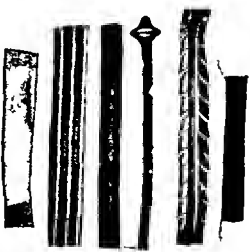


Fig 185—Commonly used rubber drains. *a* Glove drain, *b* Corrugated drain, *c* Fenestrated rubber tube *d* Self retaining drain *e* Corrugated rubber with serrations to prevent drain from slipping out of wound *f* Cigarette drain with gauze wick.

passing this stitch, care must be taken to insert it, not through the middle of the tube, but somewhat to one side, otherwise when the knot is tied the lumen will be largely obliterated After this stitch has been cut in the process of shortening of the drain, a safety pin is inserted through the tube

Removal of tubes For the same reason that the tube should be as small as will be efficient, it should be removed as soon as it is safe to do so, and if it is inadvisable to remove it altogether, it should be rotated and shortened each time the wound is dressed While it is impossible to lay down strict rules, all tubes in the vicinity of vessels or intestine must be shortened early Drains conducting serous exudates may often be removed on the day after their insertion Most abdominal drains should be removed in twenty four or forty-eight hours Strictly localized abscesses require much longer drainage, sometimes for several days, smaller and smaller tubes being inserted until no longer needed In empyemata, particularly, much discretion is to be exercised before removing the tube, seldom should it be finally discarded before the tenth day, and then only if the discharge has become small in amount and the cavity largely obliterated

Other references to the drainage of wounds will be found in various parts of the book

REMOVAL OF SUTURES

First dislodge blood-clot from projecting parts of the suture by swabbing with hydrogen peroxide Seize the knot with Spencer Wells forceps (*Fig* 186), raise

the stitch from the skin, and then snip the suture *flush with the skin* on one side and withdraw from the other

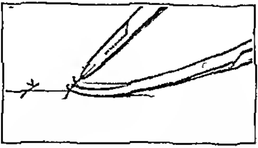


Fig 186.—Removal of sutures The knot is raised with Spencer Wells forceps and the stitch cut flush with the skin.

SECONDARY SUTURE

Secondary suture is employed when a wound, at one time infected, has been cleaned by antiseptic dressings or by the natural process of repair As soon as the bacteriological swab shows that most of the infecting organisms have been eliminated, and when the granulations appear healthy, secondary suture may be employed with safety It is advisable to freshen the skin margins and undercut the edges, but the main bulk of the granulations may be left alone

CHAPTER XXII

FACTORS IN WOUND HEALING

By Hamilton Bailey

No member of a surgical team has better opportunities of observing the healing of wounds—operative and otherwise—than the house surgeon I feel, therefore, that his attention should be directed to some of the newer thought connected with the subject, for it is he who can check results, add to our knowledge and, indeed, standardize any benefits which accrue from this research

Œdema of the Wound inhibits healing If this is realized, the following measures to prevent the occurrence of œdema will occupy the house surgeon's attention —

a General —Dilution of the large molecular content of the blood sets up intercellular œdema The danger of over-administration of intravenous saline has already been emphasized, œdema of the wound is a comparatively minor danger If there is reason to suspect that there is protein anæmia from long-continued low nitrogen intake, a plasma or blood transfusion will tend to remedy the deficiency

b Local —When possible, in order to minimize œdema in the neighbourhood of a healing wound, the aid of gravity should be invoked If sutures, particularly deep sutures, are causing local œdema, it is often advisable to remove all or certain of them and to substitute 'corsettage' to support the wound (*see* p 26)

Vitamin C Deficiency —Deficiency or absence of vitamin C has been shown to exist where a sutured wound has broken down after the sutches had been removed at the usual time It is common knowledge that in the aged and under-nourished wounds heal more slowly and less firmly Forty-four per cent of cases taken at random in surgical wards were found to be deficient in vitamin C, and all patients above 70 years of age showed a relative deficiency (A H Whipple) It is clear that a sub scurvy state delays healing and predisposes to disruption of abdominal wounds Burst abdomen is twice as common in men as in women, and Sokolov found it to be commoner in the first half of the year than in the second, and he attributes this to a lowering of the vitamin C content R T Payne believes that many deaths following such operations as partial gastrectomy are due to failure of the suture line to unite, and this failure is related to anæmia and deficiency of vitamin C It would therefore appear that the house surgeon should be vigilant in seeing that every patient whose tissues are endeavouring to repair a wound should be receiving an adequate intake of vitamin C, e g, fruit and green vegetables If, for some reason, it is impossible to supply the vitamin in this form, or the patient looks as though he is in need of an extra ration, it should be supplied in the form of ascorbic acid The full dosage is 1000 mg of ascorbic acid per day for three days, and afterwards to maintain saturation, 100 mg per day for about three weeks, while the wound is healing

Vitamin K (*see* p 189) should be given where there is bleeding from granulation tissue

Protein *v* Carbohydrate Diets—After an operation the usual practice is to keep the patient on a light diet, mainly carbohydrate, at any rate for some days The same is true in cases of suppuration It has been shown that during the first few days after the infliction of any wound (operative or otherwise), the loss of body-nitrogen is relatively high, if the wound suppurates this loss continues While the nitrogen loss is high, processes of healing are at a low ebb It has been shown experimentally that a high protein diet hastens the repair of wounds, indeed, if nitrogen is supplied, the "lag" period is diminished and wound repair commences much earlier It is, therefore, desirable that there should be a high protein intake from the commencement Milk, grated cheese, egg albumen, and pounded fish are all suitable articles of food from the earliest days Experiments in the intravenous introduction of total amino-acids of casein (usually together with routine glucose) carried out in the U S A are very hopeful, but the preparation is not yet available in this country

Accelerators of Wound Healing—An endeavour to find a substance which will accelerate healing of wounds has occupied the attention of inquiring minds for many years Carrel showed that processes of repair were set in motion by a protein derived from dead leucocytes, and that the same protein was present in embryonic tissue extract This protein was marketed under the name of Epicutan in the form of a powder It came from Denmark, and is not now available

Allantoin is another substance which has been the subject of investigations with the same object in view Existent in allantoic fluid, in the comfrey root, and in the excretions of certain maggots, allantoin appears to facilitate the removal of necrotic material, to exhibit cell-proliferating properties, and to promote healthy granulations In suitable cases my assistants and I are using this substance in two forms (*a*) 4 per cent allantoin with 96 per cent sulphanilamide, and (*b*) Pure allantoin The latter is used only on clean wounds Both are in powder form, supplied by Genatosan Ltd

CHAPTER XXIII

POST-OPERATIVE HYPNOTICS AND SEDATIVES

By Henry Cohen

Despite our incomplete knowledge of the physiology of sleep, of this we are certain that accompanying sleep there is a depressed activity of the cerebral cortex, and that *any* factor, physical or mental—be it pain, cough, nausea, vomiting, anxiety, despair, or the like—which tends to perpetuate cortical activity, hinders sleep It follows then that sleep will elude us unless we secure tranquillity of the nervous system, either (1) by removing or subduing disturbing influences, or (2) by depressing the higher brain centres and so rendering them less sensitive to these disturbances Some drugs used in the treatment of insomnia exert both actions, with others, one or other action is dominant

Before considering the use of sedative drugs in detail, it must be stressed that minor and apparently trivial discomforts—an uncomfortable pillow, a tight bandage, a cold draught, noise, or even unaccustomed silence—will prevent sleep, and correction of these is an essential part of the treatment of insomnia

The more potent hypnotics are not free from danger (1) They may result in habit formation (addiction), (2) They may exert toxic effects on vital organs, e g , the kidneys or liver, or (3) Their depressive effects may extend to the lower nerve-centres, and by interfering with such vital functions as respiration, endanger life The first two dangers are of less importance after operation, for here sedatives are used for a limited time only Where, however, the patient gives a long history of insomnia preceding operation, the more potent drugs must be prescribed with great care, lest the comfort induced by them is sought after the post-operative discomforts have passed Sedative drugs vary not only in their pain relieving (analgesic) and sleep inducing (hypnotic) properties, but also in the *duration*, *intensity*, and *rapidity* of their action No one drug can be ideal for all eventualities The problem presented by each patient differs Long experience has shown that the practitioner who is familiar with the effects of and indications for a few well tested drugs will achieve greater success by their rational use than his colleague who is inveigled into trying every new hypnotic about which he receives glowing and alluring advertisements In the appended table is given a list of the most commonly used hypnotics, with special reference to the rate, duration, and intensity of their action, and their relative analgesic and hypnotic properties

A knowledge of the action of the drugs in the Table should enable the practitioner to choose the most suitable hypnotic for any patient under his care Proprietary preparations of the opium alkaloids (e g, omnopon, pantopon) and of the barbiturate series of hypnotics are occasionally found to be better tolerated by the patient, and to have fewer undesirable side-effects, than the official B P preparations, which, however, should be one's first choice Mild analgesics (e g, aspirin) can be used with the milder sedatives if there is but slight discomfort

Hypnotic and Sedative Drugs Dosage, Actions, and Indications

Preparation	Dose (by mouth)	Acts in	Acts for	Main Action	Habit Tendency	Remarks
Opium and its derivatives, e g, Morphine hydrochloride, Diamorphine hydrochloride (1/12–⅙ gr)	⅙–¼ gr	hr ½	hr 6–8	Most powerful hypnotic and analgesic	Almost inevitable with continued use, whichever preparation is *employed*	Valuable pre anæsthetic hypnotic given ½ hour before operation potentiates action of general anæsthetic. Use with caution in post-operative respiratory complications
Bromide of Potassium or Sodium	20–30 gr	½–1	4–6	Mildly hypnotic	Nil	Especially useful in mental anxiety Palatability increased by giving in beef tea or in effervescing mixture
Chloral Hydrate	15 20 gr	½	6–8	Moderately hypnotic negligibly analgesic, except in larger doses	Very slight	Helpful, combined with bromides, *in* the restlessness following minor operations
Paraldehyde	1–2 drachms	¼	6–8	Moderately hypnotic	Negligible	Useful especially in alcoholics; unpleasant taste can be partially masked by tr aurantii or aq cinnamomi Safe hypnotic in post-operative respiratory and cardiac disturbances
Barbituric Acid Series — 1 Barbitone (Veronal) 2 Soluble Barbitone (Medinal) 3 Phenobarbitone (Gardenal or Luminal)	 5–10 gr 5–10 gr 1–2 gr	 ½–1 ½ 1	 6–8 6–8 8–10	Moderately hypnotic, very mildly analgesic Strongly hypnotic, very mildly analgesic	Mild habit commonly develops Rarely habit forming	An almost infinite number of *proprietary* preparations of this group are marketed Despite extravagant claims by *their manufacturers*, they possess no advantages over the official preparations for most patients
Sulphone Group — 1 Sulphonal 2 Methylsulphonal (Trional)	 10–20 gr 10–20 gr	 4–5 (Inconstant) ½–1	 10–12 8–10	Strongly hypnotic, mildly analgesic	Common	Rarely used because of — 1 *Inconstancy* of action 2 Severe toxic effects, e g, hæmatoporphyrinuria 3 *Habit formation*
Urea Group — 1 Carbromal (Adalin) 2 Bromural	 10–15 gr 5–10 gr	 ½ ½	 4 4	Moderately hypnotic	Very slight	*Useful in restlessness from mental* anxiety

or pain The doses given in the Table are for adults The dose of these preparations for the child is best estimated by the formula —

$$\text{Dose for child} = \text{Dose for adult} \times \frac{\text{age of child}}{20},$$

e g , a child of 10 years is given half doses Owing to the peculiar sensitivity of the child s nervous system to opium and its derivatives, these should be used in even smaller doses than are arrived at by this formula , in infants under 2 years of age opiates are best avoided

The nature of the operation which the patient has undergone and his general condition will sometimes decide the best channel of drug administration Where oral medication is inadvisable or impossible, e g , immediately after gastric operations or in severe post-operative vomiting, hypodermic injections can be used By this route the soluble barbiturates and opium derivatives can be given, the dose being approximately half that by mouth Paraldehyde is a useful hypnotic administered rectally in doses of 2 to 4 drachms diluted with ten times its volume of normal saline

It cannot be too strongly emphasized in conclusion that though drugs play an important part in the treatment of post-operative restlessness and insomnia, all distressing symptoms, e g , pain, cough, distension, etc., demand treatment in order that the desirable aim of using the smallest effective dose of hypnotic drugs be achieved

CHAPTER XXIV

POST-OPERATIVE PULMONARY COMPLICATIONS

By F Dudley Hart

Post-operative pulmonary complications are by no means rare, and are an ever-present possibility and source of anxiety to the surgeon in charge Much can be done, however, both in prevention and cure, and a thorough examination and carefully taken history will enable those pre-operative measures to be started which lessen to a marked degree the chance of pulmonary complications after operation The patient will often fall into one of the groups mentioned below, if so, appropriate prophylactic treatment is immediately commenced In arranging for the date of operation too much attention is often paid to the patient's surgical condition, to the exclusion of all other systems

Physical Examination.—A thorough physical examination is first made, paying particular attention to respiratory and cardiovascular systems, and the patient questioned as to previous illnesses The worst subject for operation is the elderly male with chronic bronchitis and or sluggish circulation, possibly with a degree of cardiac decompensation He is questioned as to his exercise tolerance, for it should be remembered that a man with an apparently normal heart who cannot walk up ten stairs without pausing for his breath is a worse subject for operation than a man with marked cardiac murmurs but an excellent exercise tolerance

Few town dwellers are free from bronchitis after the age of fifty, and males are worse than females in this respect In the London male working population chronic bronchitis in unduly prevalent, and whenever possible operation should be delayed in such subjects until the summer months A chronic catarrhal condition of the nose and throat commonly coexists

On examination the shape of the chest is important. The barrel-chested bronchitic with hyper resonant percussion note, chest held in inspiration, and diffuse râles on auscultation, has a much reduced vital capacity, and an abdominal operation will further diminish it—particularly an upper abdominal one In the young it cannot be too strongly emphasized that persistent post-tussive crepitations in the upper zones nearly always mean pulmonary tuberculosis, and a radiograph should be taken to verify this and to ascertain the extent of the disease Coarse basal crepitations, more marked on, or confined to, one base, usually mean bronchiectasis Finer moist sounds at both bases are found often in elderly subjects with a degree of pulmonary congestion The fingers should be examined for clubbing, and the position of heart and trachea noted, for bronchiectasis is commonly present in a collapsed lower lobe, with displacement of heart and mediastinum to the affected side Clubbing is not always present in this condition, *the earliest sign of it is a filling out of the nail base, with diminution of the* normal obtuse angle on the dorsum of the terminal phalanx Cyanosis and dyspnœa should be looked for A mild degree of cyanosis is best seen in lips and nail-beds, and a lilac colour of the latter should suggest pulmonary disease. Mild dyspnœa may be brought out by the exertions of examination Pallor of the ears, nail beds, and palms of the hands indicate a degree of anæmia

Prophylactic Measures.—In emergency surgery there is no time to carry out prophylactic measures, but a few simple facts should be borne in mind —

1 *Atropine* dries up the bronchial secretion and tends to make the sputum of a bronchitic subject more tenacious and less likely to be coughed up Nevertheless, given pre-operatively for inhalation (ether) anæsthesia its practical advantages outweigh its theoretical disadvantages It should not be given after operation

2 *Postural drainage*, if it can be carried out, will empty the bronchi of a bronchiectatic subject and make him a better subject for anæsthesia of any sort

3 *Morphine* should be given as little as possible pre-operatively as it tends to depress the cough reflex

In non-emergency cases in hospital for some days before operation, much can be done to improve the patient's condition. The group with chronic bronchitis and emphysema is given intensive breathing exercises to improve the vital capacity and to aerate all parts of the lung Fluids are pushed to five pints or more a day If there is difficulty in producing sputum, expectorants may be given, but they are often of little use Ammonium carbonate in doses of 5 to 8 gr t d s is the most effective Potassium iodide in doses of 5 to 10 gr t d s helps to liquefy the sputum Atropine should not be given to this class of patient If the cough is wearing out the patient and is not productive of sputum, linctus codeinæ is the most efficient sedative Nasopharyngeal catarrh can be improved by inhalations of menthol or Friars' balsam Benzedrine inhalations will help to clear an obstructed nose Oral hygiene is attended to, and mouth-washes and gargles ordered

Subjects with bronchial spasm may be given ephedrine tablets, gr ½ t d s, and a mixture containing stramonium and potassium iodide With a recent exacerbation of symptoms in such cases it is wise to delay operation until the patient's condition improves

In many cases there is an element of cardiac decompensation In such cases pulmonary congestion is the cause of the shortness of breath and the cough Such cases may show no signs of venous congestion elsewhere (œdema of the legs, distended veins in the neck, hepatic enlargement, etc), and the failure may be confined to the left heart These patients usually have a high blood-pressure, and rest alone, propped up on several pillows day and night, works wonders

Another group to be watched is that with sluggish circulation, low blood-pressure, and atheroma of the arteries, for post-operative thrombosis is relatively common, and this may lead to pulmonary embolism Clotting in the popliteal, femoral, and iliac veins is perhaps more common than is thought, and if the lungs are congested pulmonary infarction is the more likely to occur The two lines of preventive treatment are therefore (1) To relieve the pulmonary congestion by strict rest, and (2) To improve the peripheral circulation by massage and active and passive movements of the legs, raising and depressing them for several minutes two or three times a day, taking the level of the 4th rib anteriorly as the resting point Tab thyroid gr ½–2 twice or thrice daily has been advocated

Prophylactic measures after operation are of even greater importance There are four main 'don'ts' (1) Don't have abdominal binders so tight that they interfere with respiration, (2) Don't immobilize the patient completely, but encourage simple movements of limbs and trunk, (3) Don't depress the cough reflex unnecessarily, (4) Don't give atropine

There are two classes of patient to watch with particular care (1) The bronchitic or 'bubbly' subject, particularly if aged and stout, recovering from an upper abdominal operation, (2) The patient with sluggish circulation The former is a potential case of massive collapse of the lung or pneumonia, and so should be encouraged to expectorate his sputum and to use all parts of his lungs as much as possible Fluids should be given in plentiful amounts—5–8 pints a day by mouth—and breathing exercises instituted to encourage basal expansion and abdominal (diaphragmatic) breathing unless this causes too much pain.

He should not be kept still in one position, but be encouraged to move about in bed Morphine should only be given if pain is severe and wearing the patient out, in such cases it should not be withheld Atropine should never be given A linctus is useful if the cough is very troublesome Overbreathing may be encouraged by CO_2 inhalations if collapse of the lung seems imminent The second group should continue with those measures started before operation—massage, movements, and, if thought advisable, small doses of thyroid extract A careful watch is kept for signs of thrombosis in the legs, as these may be slight and easily overlooked Expose the legs daily and note (1) If one leg cools more slowly than the other (The dorsal surfaces of the middle phalanges of one's hands are very sensitive to differences in temperature and make good thermometers) (2) If there is tenderness over one leg These two signs may be the only ones, or there may develop pain, œdema, and cyanosis with fullness of the small superficial veins in the affected leg Delayed cooling and slight tenderness, especially if associated with a rise in temperature and pulse rate, enables the diagnosis of thrombosis to be made even though the more obvious signs may not occur The affected leg is immobilized slightly flexed at the knee and raised a little on a suitable support—pillows or a splint When elevation has lessened the swelling an elastic stocking or an Elastoplast bandage may be applied, for this eases the pain and prevents a return of the swelling The patient is encouraged to use the other leg and ' to be active from the waist up ", but not to use the affected leg Massage and active and passive movements may be ordered for the unaffected leg Purging is, as always, contra-indicated, and the bowels should be controlled by laxatives and enemata

Heparin Heparin has been used successfully in the prevention of post-operative thrombosis and pulmonary embolization The usual procedure is to keep the clotting time between 15–20 minutes by introducing heparin in a continuous intravenous drip It is best instituted immediately after operation or at the first sign of thrombosis in the leg

Pulmonary complications which may follow operation range from slight tracheitis to pulmonary embolism Only the more important are discussed here

POST-OPERATIVE BRONCHITIS

Post-operative bronchitis is usually an exacerbation of a similar pre-existing condition Precipitating factors are constriction and immobility of the chest, badly administered anæsthesia—especially if overmuch ether is given—and chilling and exposure on the trolley or operating table Symptoms usually commence within thirty-six hours of operation cough, a variable amount of frothy or mucopurulent sputum, substernal discomfort, and general distress There may be a degree of fever lasting a few hours or days, depending on the severity of the condition As coughing causes pain in the abdominal wound, the tendency is for the patient to cough less than he should, and so remain unduly bubbly The physical signs are those of an ordinary bronchitis—diffuse rhonchi and crepitations If the larynx is affected hoarseness or aphonia is present A dry, very hacking cough indicates tracheitus

Complications —Bronchopneumonia, collapse of the lung

Treatment.—Remove pain as much as possible, for this leads to an increase in coughing and greater production of sputum Usually the more common analgesics, such as aspirin and/or codeine, are sufficient Morphine should only be given if severe pain is not controlled by such drugs Fluids are given

generously and the patient is encouraged to move about in bed to some extent Sleep should be sound but not stuporous, therefore sedatives such as bromide or chloral or the milder barbiturates are given accordingly If the cough is very irritable and non productive, a soothing linctus, such as linctus codeinæ, is given occasionally If there is respiratory distress a steam kettle may give relief, with creosote or tinct benz co, 1 drachm to 1 pint added A Gamgee pneumonia jacket may give the patient comfort Care is taken to encourage deep breathing and to avoid constriction of the chest If the breath sounds become weaker at one base in a chest full of moist sounds it is wise to stimulate respiration (and thereby expectoration) by giving vigorous breathing exercises and CO_2 (5 per cent) and O_2 (95 per cent) inhalations by a mask, a glass funnel is useless Physical signs such as are described above often precede massive collapse of the lower lobe of a lung, which can be prevented by these timely measures

ACUTE SUPPURATIVE BRONCHITIS

(*Septic Bronchitis*)

Acute suppurative bronchitis is not common after operation It occurs within twenty four hours of the patient leaving the table, and is characterized by shivering, high fever, dyspnœa, and cyanosis Physical signs are diffuse bubbling rales and a weakness of the breath sounds The purulent sputum becomes very copious A fatal bronchopneumonia often ends the scene

Treatment —Abundant fluids are given by the mouth Brandy soothes the patient An oxygen tent may give relief The contents of the bronchi may be aspirated through a bronchoscope, but the patient is usually very ill, so should not be moved more than is absolutely necessary Of the stimulants strychnine gr $\frac{1}{30}$, injected subcutaneously, and lobeline 3 mg in 1 c c of water, intravenously, are the most useful

MASSIVE COLLAPSE OF THE LUNG

Massive collapse of the lung is the collapse of all lobes of one side due to obstruction of the lumen of the main bronchus from within, from without, or from a combination of both A single lobe may collapse from obstruction of its main bronchus

Such a condition occurs post operatively from mucus inhalation in a partially immobilized lung with impaired basal (diaphragmatic) movement, and though perhaps more frequent after a 'bubbly' general anæsthesia, also occurs after non inhalation anæsthesia Collapse may be seen after inhalation of a foreign body (toy whistle, peanut, etc), plugging of a bronchus narrowed by a growth, or may arise from various other causes Symptoms may be slight or absent, or there may be severe discomfort in the side, dyspnœa, and shock. Physical signs are those of consolidation, with shift of heart and/or trachea towards the affected side, with raising of the diaphragm on that side The condition may be indistinguishable from pneumonia, but the onset is more acute, and it tends to occur in the first forty eight hours after operation The temperature commonly rises abruptly at the onset A radiograph will verify the diagnosis, and should always be taken if the condition is suspected, as many cases give no physical signs

Treatment —*Prophylactic* —The measures outlined on page 151 are all important It is essential for the 'bubbly' post-operative patient to clear his chest by coughing, therefore he is told to support the abdomen in the region of the wound with his hands and cough up all sputum, even though this may cause

some discomfort A better method is shown in *Fig* 187, by adopting this procedure the patient is enabled to rid himself of much sputum Body movement is encouraged, fluids given in plenty, and breathing exercises taught

After collapse has occurred the same measures are persevered with, and the following should also be tried —

1 Roll the patient on to the sound side and lower the head, so that the affected lung is the highest part, being raised on pillows Encourage the patient to cough, and with the left hand flat over the collapsed lung strike smartly with the right fist on the back of the left hand (*Fig* 188) Thus postural percussion drainage, if practised soon after collapse has occurred, loosens the mucous plug, which is dislodged towards the trachea and coughed up, allowing re-expansion to occur This method is not as brutal as it sounds, and may even be carried out on the first day after operation

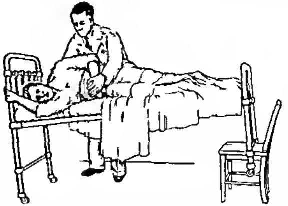


Fig 187 —The knees are drawn up and the foot of the bed raised on a chair An abdominal binder the patient's hand and the clinician's hand all guard the abdominal incision The clinician's other hand keeps the patient rolled towards his abdomen This hand also detects the clearing of rhonchi as mucus is coughed up (*After A E. Moore*)

Fig 188 —Postural percussion drainage in massive collapse of the lung

2 Combine with the above, if unsuccessful, CO_2 (5 to 10 per cent) and O (90 to 95 per cent) inhalations by mask, to cause overbreathing and expansion o

the lung Respirations become deeper, coughing occurs, and often the plug is coughed up shortly afterwards

3 If, after some days, collapse is still present, an artificial pneumothorax may be induced The excessively high intrapleural negative pressure subsequent on collapse (– 44 to – 40 or thereabouts) is thus reduced, and the displaced mediastinum returns to its normal position

If the collapse be caused by a foreign body, bronchoscopy and removal is the obvious treatment, but if mucus or soft tissue has been the cause, it is so rapidly sucked into the smaller bronchi that anything but immediate bronchoscopy is generally useless A patient a day or so after an operation is usually in no fit state for bronchoscopy, even if indicated

POST-OPERATIVE PNEUMONIA

Pneumococcal lobar pneumonia is a rarity after operation, and a consolidation of one area alone should suggest collapse rather than pneumonic consolidation Bronchopneumonia may occur rapidly, within a few hours of operation, in a weak and enfeebled subject, the sooner it occurs the more severe it tends to be It is more common several days later, often superimposed upon a post-operative bronchitis

Treatment —This in no way differs from that of an ordinary bronchopneumonia, and is largely palliative The most useful measures are (1) The oxygen tent for the cyanosed, distressed patient, (2) Strict rest and skilful nursing —the patient should not have to move to do anything, but is kept still, propped up on several pillows, (3) Plentiful glucose drinks and other fluids, (4) Tepid sponging to reduce high temperatures, (5) Brandy or whisky as sedatives, (6) Care of the mouth, (7) Attention to any abdominal distension, (8) Sedatives to ensure rest This is most important, for the entire treatment is aimed at giving the patient as much help as possible, to aid his natural recovery, but with little interference Rest and sleep are therefore essential The patient should receive as little handling as will allow him to spend a comparatively comfortable day and a restful night A Gamgee jacket is useful, applied so that it fastens down the sides and allows for easy examination of the chest Antiphlogistine may be applied over an area of pleurisy, subject to the patient's approval Careful watch should be kept for cardiac or peripheral failure Venesection is often helpful if congestive cardiac failure supervenes

Collapse or Pneumonia —These two conditions are so frequently confused that it is as well to compare them Correct and immediate diagnosis is essential, as the treatment for the two conditions is exactly opposite A radiograph should always be taken at the earliest opportunity The following are the main points —

Pneumonia	*Collapse of the Lung*
Gradual onset	Sudden onset
Occurs usually after fifth day	Occurs usually within 72 hours of operation
Physical signs of consolidation	Physical signs of consolidation
No mediastinal displacement	Mediastinal and diaphragmatic displacement
Patient toxic	Patient rarely toxic
Treatment Immobility	Treatment Mobility

The last point is most important While the patient with pneumonia is treated by strict rest, the patient with collapse is encouraged to move and is given 'the freedom of the bed' Collapse is the more common post-operative condition, and follows fractures of ribs and femora as well as abdominal operations It should therefore be suspected in all cases presenting *sudden* pulmonary symptoms and signs within fourteen days of operation The signs and symptoms may be very deceptive Cardiac displacement is *the* important sign, for the signs of consolidation given by the collapsed lobe may be obscured by a compensatory emphysema of the other lobe or lobes The importance of the condition lies in the rapid onset of bronchiectasis in the collapsed lobe if expansion does not occur within a few days

"Collapse-pneumonitis."—Many cases of post-operative pulmonary consolidation fall into a class presenting signs suggestive of collapse *and* inflammation, i e, inflammation and impaired bronchial drainage These are the cases occurring shortly after operation—1–5 days usually—which have clinical and radiological signs of basal consolidation without definite diaphragmatic and mediastinal displacement

They should be treated essentially as cases of collapse, but if the temperature chart and pulse of the patient suggest pneumonia the more vigorous methods should be withheld and chemotherapy instituted—sulphapyridine or sulphathiazole With both drugs the tablets are best given crushed up with 5–10 gr of sodium bicarbonate and a little mucilage added

The dosage for an adult is 2–3 g statim, then 1 g four-hourly until the temperature has been normal, or almost so, for 12–24 hours Sulphathiazole is less likely to make the patient vomit and may be preferred in gastric cases In cases unable to swallow, the soluble form of either drug may be given intravenously, though this will not remove the tendency to vomit A striking response will only take place if the organism responsible (usually the pneumococcus) is sensitive to chemotherapy

PULMONARY SUPPURATION

This may occur in three forms (1) Diffuse suppurative pneumonitis, (2) Lung abscess, (3) Empyema

1. Diffuse Suppurative Pneumonitis—This condition is uncommon, and is to all intents and purposes indistinguishable from bronchopneumonia The patient is very ill, the prognosis bad It may occasionally progress to a chronic form Treatment is palliative, though bronchoscopic aspiration may be performed Chemotherapy—sulphathiazole or sulphapyridine—should be instituted

2. Lung Abscess—This condition may occur as a blood-borne infection or from inhalation of foreign bodies and/or infected material As it most commonly occurs after operations on nose, throat, or mouth (e g, dental extractions, tonsillectomy), infection by inhalation seems the more likely as a general rule Aspiration abscesses are usually one or two in number, embolic abscesses multiple

The onset of signs and symptoms is usually seven to seventeen days after operation The patient suddenly develops a high temperature which continues as an intermittent fever He sweats, has a marked tachycardia, and looks ill A cough may then appear, at first unproductive In many cases the sudden

expectoration of foul purulent matter in large amounts (10 to 20 oz) leads to spontaneous resolution A bad odour may become apparent in the breath, and this often immediately precedes spontaneous resolution Slight hæmoptysis may occur Physical signs are dependent on the position of the abscess and the condition of the rest of the lung Radiographs—antero-posterior and lateral—should be taken to verify the diagnosis and to locate accurately the collection of pus

Treatment —A waiting period of two to six weeks is commonly advocated, with postural-percussion drainage (as outlined in the section on MASSIVE COLLAPSE) and bronchoscopic aspiration If after this time resolution has not occurred the thoracic surgeon is called in If copious expectoration occurs, and the abscess becomes an open one, draining into the bronchus, postural drainage is performed on the Nelson bed, the position of the patient depending on the site of the abscess Chemotherapy may help in some cases, but is often unsatisfactory, and the waiting period should not be extended unless definite radiological improvement takes place Delay in operation may be disastrous

3. Post-operative Empyema —This is uncommon except after lobectomy

PULMONARY EMBOLISM

Pulmonary embolism is the most dangerous of all post-operative complications It occurs more particularly in the older patient, especially if stout and with poor circulation, usually six to sixteen days after operation The embolus usually comes from a femoral or iliac thrombosis, though there may be no sign in the leg of this condition, and is immediately preceded by a slight rise in temperature The effect produced varies with the condition of the patient's lung and the size of the embolus A small embolus which produces no effect in a normal lung may cause all the signs and symptoms of pulmonary infarction in a congested one

There are two main types —

1 The large embolus which lodges in the bifurcation of the pulmonary artery, temporarily occluding one, commonly the right, or both branches The onset is dramatic in its suddenness The patient in a moment becomes very shocked, pale, and sweating, with a sense of impending death and a strong desire to go to stool. The blood pressure falls, the pulse becomes rapid and often irregular, and may become imperceptible If the right heart fails, cyanosis replaces pallor A sense of constriction or actual pain is felt in the centre of the chest and the patient feels himself rapidly 'slipping away' Death often occurs within a few minutes, but may be some hours or days later A patient may recover, only to die from a second embolus at any time within the next two weeks Recovery occasionally takes place

Treatment —Treatment is for shock An injection of morphine may be given Masterly inactivity is the line to take, with the patient on strict absolute rest

2 The smaller embolus, which passes through the pulmonary artery, usually without causing symptoms, lodges in the lung, and causes symptoms and sometimes signs of pulmonary infarction with overlying pleurisy The right base is the area most commonly affected The patient experiences pain in the affected area in taking a breath or on coughing, and often coughs up blood-clot within forty-eight hours The onset may sometimes be more gradual, simulating muscle pains The physical signs vary from nothing at all to those of consolidation with overlying pleurisy The findings are so uncertain that the diagnosis

has often to be made on the history of sudden pleurisy arising within sixteen days of operation The expectoration of blood-clot verifies the diagnosis Radiographs show a clouding of the affected lung field with obliteration of the costophrenic angle

Treatment —Palliative Rest and analgesics are of most importance A search is made for signs of thrombosis in the legs, and adequate treatment is instituted

It will be noted that of the pre- and post-operative measures, the giving of fluids by mouth in as large amounts as the patient will take, and encouragement of movements of legs, diaphragm, and chest, are of primary importance in almost all the above conditions Inertia, hypoventilation of the lungs, dehydration, and repression of the cough reflex are to be avoided at all costs in the patient both before and after operation Once the complication has occurred, treatment is sharply divided according to two main groups (1) Those conditions requiring strict rest and masterly inactivity, and (2) Those conditions requiring the opposite line of treatment

Fat Embolism —Fat embolism is probably more common than was previously thought Usually occurring after fractures—simple or compound—it may also occur after laceration of soft structures and severe burns

Clinical Picture —After the injury there is usually an interval varying from a few hours to four days in which the patient is comparatively well apart from the shock and other symptoms directly due to the injury He then becomes very dyspnœic, pale and/or cyanotic, sweats, and is restless Temperature, pulse, and respiration-rate rise, but the blood pressure remains approximately normal There is little coughing, but frothy sputum, sometimes tinged with blood, may appear round the lips The patient is too ill to complain of much, cerebral symptoms such as fits, palsies, and stupor may supervene at this stage Purpura may be present, the commonest type being small petechial hæmorrhages over the upper part of the chest, the shoulders, and the anterior part of the neck

Prophylaxis —Unnecessary or rough handling of the affected part should be avoided, and delay in reduction and immobilization of a fractured bone avoided Early immobilization of the affected part is the most important single prophylactic measure

Treatment —Anoxæmia should be relieved by administration of oxygen by mask or in a tent Morphine should only be given when absolutely necessary owing to its respiratory depressant action In the general management of the case it should be remembered that —

a There is often a degree of pulmonary œdema, and therefore intravenous infusions are frequently contra indicated Injections of atropine may or may not lessen the pulmonary œdema

b If there is venous engorgement or other signs of heart failure, venesection of a few ounces is indicated, providing there are no contra indications (anæmia, shock, etc)

c If intravenous infusion therapy is essential it is best given early before pulmonary symptoms become marked—blood, plasma, or serum Salines are contra indicated

d Pneumonia may supervene and require the appropriate treatment

e Restlessness is best treated by barbiturates

USEFUL PRESCRIPTIONS

Sedatives for Troublesome Unproductive Cough.—

Linctus Codeinæ

℞ Syr Codein Phos ♏xx
Glycerini ♏xx
Succi Limonis ♏xviij
Spirit Chlorof ♏ij

Sig To be given when the cough is very troublesome, particularly at night

Linctus Simplex

℞ Theriacæ ♏xx
Spirit Chlorof ♏ij
Aquam ad fl dr j

Sig As directed, when the cough is troublesome

Expectorants—To assist in the production of sputum where secretion is present in the bronchi but is unable to be expectorated

Mist Nucis Vomicæ cum Ammonio

℞ Tinct. Nuc. Vom. ♏iij
Ammon Carb gr vii
Spirit Chlorof ♏v
Infus Quassiæ ad fl oz. j

Sig To be taken every four hours

Mist Pot Iod

℞ Pot Iod gr x
Ammon Carb gr v
Spirit Chlorof ♏v
Aquam ad fl oz. j

Sig Three or four times daily as directed

Expectorant and Antispasmodic.—

Mist Pot Iod cum Stramon

℞ Tinct. Stramon ♏v
Extract Glycyrrhizæ Liq ♏xx
Pot Iod gr iv
Spirit. Chlorof ♏v
Aquam ad fl oz. j

Sig Three or four times daily as directed

Inhalations—For catarrhal conditions of the nasopharynx, larynx, and large bronchi The steam is inhaled with a towel enclosing head and container

Vapor Creosoti

℞ Creosoti ♏x
Mag Carb Lev gr x
Aquam ad fl dr ij
Aquæ Ferventis (temp 60° C.) fl oz xx

Sig The vapour to be inhaled as directed

Vapor Mentholis

℞ Menthol gr j
Spirit. Rectif ad fl dr j
Aquæ Ferventis (temp 60° C.) fl oz xx

Sig Vapour to be inhaled as directed

Solutio Creosoti Co Inhalation for use on oro-nasal inhalator

℞ Creosoti
Spirit Menthol. (20 per cent)
Spirit. Chlorof } equal parts

CHAPTER XXV

HEAD INJURIES

By Hamilton Bailey

Injuries to the head and brain are among the most important cases with which the house surgeon has to deal. There is no doubt that it is impossible always to estimate the amount of damage sustained. It follows that it is imperative to examine these cases with scrupulous care, and to consult with one's colleagues in cases of doubt. This may lead to the admission of some cases unnecessarily, but this is far better than the overlooking of a fracture of the base.

It is necessary to train oneself to refrain from prejudgement in 'unconscious' cases. 'Drunk or dying?' has always been an anxious problem for the house surgeon. The succumbing of a patient following inaccurate diagnosis and discharge from hospital does the reputation of the institution and the medical profession an immense amount of harm. It is of paramount importance to examine unconscious patients thoroughly, and in this connexion the table on p. 165 is of service.

Dealing now with the case of undoubted head injury, it is important to make notes at once. Apart from the value of accurate notes for diagnosis and treatment, in this instance they will be required almost certainly for some form of legal report. Where, exactly when, and how did the accident occur? Did the patient lose consciousness at once? Has he been conscious at any time since the accident?

After examining the patient, record the depth of consciousness and the position of wounds and bruises. If there is bleeding from the nose or ear, record this. Also make a note of the condition of the pupils and the result of gross neurological examination. *Above all, do not fail to examine the whole patient, for it is more than possible that he has other injuries.*

An excellent rule in connexion with head injuries is that every patient who has been even slightly concussed should be confined to bed for at least fourteen days.

SCALP WOUNDS

To encircle the operative area with local anæsthetic, as shown in *Fig.* 189, meets every requirement. The use of local anæsthesia necessitates wide shaving of the operative area, which is all to the good from other points of view.

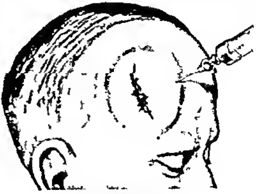


Fig. 189.—Method of infiltrating the scalp with local anæsthetic in a case of a scalp wound.

Strong curved scissors are better than a scalpel for excising the wound edges Bleeding vessels are secured by a series of hæmostats The larger arteries are dealt with by undersewing them Minor bleeding points need not be ligated, the hæmostats are left on until the wound edges are approximated by the skin sutures The depths of the wound must be inspected, if available, a mastoid type of mechanical retractor facilitates this step Road grit, glass, hair and such like are picked out, and the wound irrigated with saline All bruised, torn, and ragged tissue is snipped away until the whole area presents an indubitably clean cut appearance The wound is then insufflated with sulphanilamide powder, and the retractor is removed

Suturing the Scalp—With the hæmostats still in position, deep strong skin sutures are passed through the scalp, using a fully curved cutting needle As the skin sutures are tied the hæmostats are removed (*Fig* 190) It is most important that the wound edges should be brought together without tension, for post-operative œdema often occurs If there is tension there should be no hesitation in stripping up the scalp from the pericranium The scalp, when loosened in this manner, allows the wound edges to be drawn together kindly Norman Dott recommends that interrupted deep sutures of fine silk should be used to bring the edges of the aponeurosis together After this has been done the scalp can be drawn together easily by skin sutures which need not be tied tightly This prevents local necrosis due to tension on the suture line Usually healing *per primam* can be expected It must be remembered that it is just as necessary to administer prophylactic doses of antitetanic and anti gas gangrene serum as it is in the case of other lacerated wounds If infection ensues—a rare event if the débridement has been carried out properly—stitches must be removed forthwith and fomentations applied

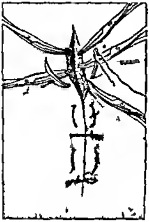


Fig 190—A method of suturing the scalp

Dressing Major Head Wounds, including Operative Wounds—The method illustrated in *Fig* 191 cannot be bettered

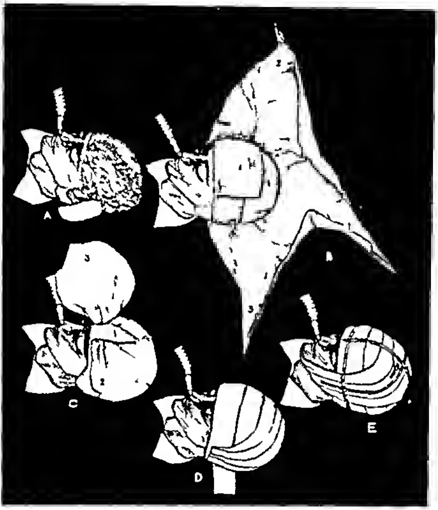
The Care of the Unconscious Patient—The house surgeon should organize a system which ensures that the patient is watched carefully For noisy, trouble some patients a male attendant is essential—it is not a nurse's duty to struggle with unruly patients, but to record the pulse temperature, and respirations

It is true that in most cases the less we do for a severe head injury the better —if left alone many, perhaps 70 per cent, deeply concussed patients recover uneventfully It is to try to save a larger proportion of the remaining 30 per cent that the following meticulous, watchful care is inaugurated

Special Charts recording accurate observations should be the pride of those in attendance The house surgeon himself commences with the first recorded reading, that of the blood pressure

The significance of a slowing of the pulse-rate is known generally, and the hourly pulse rate is a routine in most hospitals The diagnostic value of a very frequent temperature record is not appreciated so widely W O Stevenson states that the temperature should be taken every fifteen minutes A large

Fig 191 —NORMAN DOTT'S METHOD OF DRESSING THE HEAD



A The scalp in the region of the operative area is smeared liberally with vaseline The ears having been smeared also pads of cotton wool are placed behind and in front of the ears as shown.

B Large gauze pads soaked in 1 2000 perchloride or other mild antiseptic lotion cover the area of operation.

C A triangular bandage made by suitably folding dry gauze is placed beneath the head.

D The triangular bandage is folded about the head as shown to form a close-fitting cap

E The cap is kept in place by a gauze roller bandage applied transversely and finally beneath the chin and fanwise over the vertex. The bandage is fixed with 2½ in. adhesive tape.

thermometer, not necessarily a clinical one (*Fig* 192) can be placed in the axilla or in the groin It can be read in these positions without being removed The rationale of this seemingly hyper-careful procedure is as follows In deeply concussed patients no one knows when the stage of reaction is coming If it is purely a stage of reaction the temperature rises precipitately to a maximum of

100 5° F, and then begins to fall In cases of intracranial hæmorrhage it does not fall, but continues in its upward course and may reach 104° F

Nursing Instructions—The house surgeon should tell the nurse to call him —

1 If the temperature rises above 100 5° F
2 If the pulse rate falls to 60 or rises above 130
3 If the respirations become stertorous or irregular
4 If there is a discrepancy in the size of the pupils
5 If there are fits or paralysis

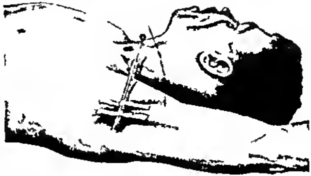


Fig 192—Method of strapping a commercial as opposed to a clinical thermometer When the arm is placed by the side a reading can be taken without removing the instrument

Posture—The correct position in which to nurse an unconscious patient suffering from a head injury is to remove the pillow and allow the patient to lie quite flat in bed This routine should not be followed slavishly, but tempered with common sense Should the depth of unconsciousness be such that bronchial secretions accumulate in the air passages Coleman's postural drainage for the unconscious (*Fig* 193) should be adopted at once The patient is placed in the lateral position and maintained there by sandbags The foot of the bed is raised 15 in on blocks To have at hand a Hewitt's air way and if possible a sucker to clear away secretion as it accumulates, not only diminishes cyanosis, which must add to cerebral congestion, but the liability to pulmonary infection—a grave complication—is also lessened Useful as is Coleman's postural drainage it should not be maintained for more than three or four hours at a time

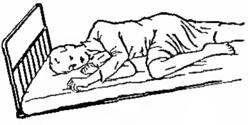


Fig 193—Coleman's postural drainage for the unconscious The position is maintained by sandbags

Feeding—Even an unconscious patient needs nourishment. The passage of a gastric aspiration tube allows an adequate intake Before feeds are poured down the tube some sterile water should be allowed to gravitate If this experiment is successful, food can follow

An adult should be given 600 c c of a mixture of eggs milk, and sugar three times a day

Differential Diagnosis of Unconscious States

	Alcoholism	Apoplexy	Compression	Concussion	Post epileptic	Opium Poisoning	Uræmia
Onset	Gradual	Sudden	Gradual	Sudden	Preceded by fit	Gradual	Sudden or gradual
General condition	Can be roused	Cannot be roused	Cannot be roused	Can be roused	Cannot be roused	Cannot be roused	Cannot be roused
Pupils	Dilated	Dilated, immobile	Dilated, immobile, unequal	Equal, react	Variable	Pin point	Variable, probably contracted
Pulse	Full	Slow, full, tension +	Slow, full, heaving	Slow and weak	Becoming less rapid	Slow and compressible	High tension
Respiration	Deep, slight stertor	Slow, stertorous	Slow, deep, stertorous	Slow, shallow, irregular	Noisy or stertorous	Laboured, irregular, stertorous	
Muscles	Twitching	Hemiplegia	Organic paralysis	Functional paralysis	Relaxed	Relaxed	Recurrent convulsions
Reflexes	Present	Absent	Absent	Present	Increased	Present	
Bladder		Involuntary micturition	False incontinence	Incontinence	May be incontinence	False incontinence	
Rectum		Involuntary passing of fæces	Incontinence of fæces	Incontinence	May be incontinence	No evacuation	
Temperature	Subnormal	Subnormal (high in pontine)	Subnormal, rising later May be unequal on the two sides	Subnormal	Raised		Subnormal
Special points	Face flushed Absence of alcoholic odour in breath excludes	Face cyanosed or grey Conjugate deviation of eyes towards lesion May be albumin in urine			Cyanosis, decreasing Tongue bitten	Odour of breath Face pallid Skin sweating All secretions except sweat diminished	Look for retinitis Albumin in urine Tongue furred Breath foul

FRACTURES OF THE SKULL

Fissured Fractures —In the absence of some signs pointing to remediable mischief within the skull, fissured fractures should be left alone

Many times I have been called to see a case where the bouse surgeon has found, or thought that he has found, a fissured fracture The picture of a fissured fracture of the outer table with extensive comminution of the inner is riveted in the mind of the student. In reality I believe this to be the greatest rarity Should there be some hidden lesion, physical signs will indicate that the skull must be opened

In the absence of signs of cerebral compression all that is necessary in the first instance is that the scalp wound be treated in the manner described on p 161 The patient is then watcbed, as should be the routine in all cases of bead injury The only variation in the routine procedure is that the help of a radiograph will be sought at the earliest possible opportunity, wbereas in the case of simple concussion the radiograph is taken at any time before the patient leaves hospital

It is quite another matter when hair or other foreign matter can be seen driven into a fissured fracture—under these circumstances the house surgeon should report for instructions

Depressed Fracture —A patient with a depressed fracture which is not compound need not be rusbed to the theatre If the scalp has been shaved it is good practice to allow the patient time to recover from the sbock of his accident A subperiosteal hæmatoma can simulate the clinical features of a depressed fracture to a nicety, therefore, if the facilities exist, the diagnosis sbould be confirmed by a portable X-ray apparatus

If real doubt exists, after shaving and disinfecting the area, there is no objection to inserting a wide-bore needle, or even making a small incision which will enable a recent hæmatoma to be evacuated

Compound Depressed Fracture —Compound depressed fractures are quite another matter, no time should be lost in making arrangements for trephining and elevating the depression

Fractures of tbe Base —The routine outlined in the care of the unconscious is followed If blood or cerebrospinal fluid is issuing from the ear, the discharge is mopped up at intervals with sterile wool The ears should not be plugged Conversely, if cerebrospinal fluid and blood are coming down the nose, very light plugging of the nares with sterile cotton-wool soaked in mercurochrome or flavine solution is a good practice When intrameningeal contents are leaking externally it is obvious that the patient is in imminent danger of ascending meningitis To attempt to prevent this, urotropine is indicated Intravenous urotropine, 5 c c of a 40 per cent solution, is supplied in ampoules by Schering This is certainly a good method of getting urotropine into the circulation It is soon excreted in the cerebrospinal fluid Alternatively sulphanilamide may be prescribed

The treatment of fractured base is largely symptomatic Increased intracranial tension is reduced by one of the methods described below Magnesium sulphate per rectum is the best, but if this is not tolerated, daily lumbar puncture is extremely effective About 10 c c of cerebrospinal fluid are removed at eacb puncture One should bear in mind that persistent bleeding from the ear may be due to middle meningeal hæmorrhage, which decompresses itself by this route

If the patient is restless, the question will arise as to the best drug to prescribe Maniacal behaviour can sometimes be controlled by simple drugs, such as a full dose of bromide Paraldehyde per rectum often produces restful sleep

The consensus of opinion is that morphia and its derivatives are contra-indicated in these cases When driven to desperation I have, on many occasions, prescribed small repeated doses of hyoscine and have not had occasion to regret it

ACUTE CEREBRAL COMPRESSION

Cases of middle meningeal hæmorrhage are few and far between, but, like a thief in the night, they come when least expected It is largely to ensure that we do not allow one of these supremely remediable cases to remain undiagnosed early that we are at pains to organize a system which ensures constant watch on the concussed patient If a patient is admitted with signs of cerebral compression it is, of course, possible that the hæmorrhage is extradural In practice we find that many of these patients are suffering from intradural hæmorrhage with laceration of the brain In every case of cerebral compression a consultation should be arranged with the surgeon A full account of the physical signs and half-hourly pulse-rate and blood pressure readings should be available

All cases of early acute cerebral compression should have the scalp shaved This allows a thorough examination of the vertex A tell-tale hæmatoma which had been obscured by hair may be revealed Should the compression increase and operation become necessary, much time is saved by having the head in a state of preparation for surgical intervention

CEREBRAL IRRITATION

The patient should be placed in a darkened room with a special attendant to look after him If magnesium sulphate can be given per rectum and retained, so much the better Half an ounce of paraldehyde can be added to the first dose and may ensure some much needed rest If the rectal injection is not retained, magnesium sulphate may be added to the feeds, for the patient will usually take fluid from a feeding cup If symptoms of cerebral irritation persist for forty-eight hours the house surgeon should consult his chief, for if cerebral irritation persists some surgeons favour dehydrating the brain by means of intravenous sucrose or even performing subtemporal decompression

INCREASED INTRACRANIAL TENSION

Apart from keeping constant vigil for the signs of intracranial hæmorrhage, the house surgeon is again reminded that his attitude towards a case of head injury should be ultra-conservative He departs from this path only when he is convinced the patient is suffering from some degree of increased intracranial tension Commonly this is observed when a severe reaction follows awakening from the concussed state Persistent headache is a leading symptom The danger of decreasing intracranial tension is increasing intracranial hæmorrhage, therefore it should never be employed unless this diagnosis has been ruled out From a practical standpoint this danger has passed forty-eight hours after admission, and it is seldom necessary to resort to any of the following before that time —

Methods of Reducing Increased Intracranial Tension —

Posture —Presuming the patient is now conscious, the blood-pressure, which, by the way, should have been recorded on several previous occasions, is taken once again If the reading is above normal the patient should be propped up gradually into low Fowler's position Should the headache persist in spite of other therapeutic measures, after a few hours he can be still further elevated into high Fowler's position

Magnesium Sulphate per Rectum—Three ounces of crystals are dissolved in six ounces of warm water By means of a catheter the resulting solution is run slowly into the rectum It must gravitate slowly in order to avoid acting as an enema The intake of fluids is restricted to two pints daily during the dehydration treatment The injection should be repeated every four hours until the symptoms have abated No toxic effects have been observed in a large number of administrations of magnesium sulphate by many observers This is the best and safest method of reducing increased intracranial pressure and it is the one which should be adopted for general use

Lumbar Puncture—The puncture is made with a fine needle, and 5 to 10 c.c of fluid are evacuated slowly The puncture may be repeated, if necessary, in twelve or twenty-four hours Manometric readings (Chapter LV) are desirable The amount of cerebrospinal fluid to be withdrawn can then be measured with scientific accuracy.

Caffeine Sodio-benzoate—At the Bellevue Hospital, New York, caffeine sodio-benzoate is given every four hours in 7½-gr doses

Intravenous Sucrose—This is a much more drastic measure and in my opinion it should not be employed by the house surgeon unless he has consulted with his chief Intravenous sucrose (cane sugar) has replaced hypertonic saline and hypertonic dextrose with much advantage, for with sucrose there is an absence of what is called 'rebound'. Fifty per cent sucrose in doses of 50 to 100 c c. is used This treacly solution is gravitated into a vein. When used in the appropriate case the effect of dehydrating the brain is dramatic, and there is no objection to repeating the dose every four to six hours should it be necessary Sucrose is entirely non toxic and it is not metabolized, but excreted in the urine

CHAPTER XXVI

THE MANAGEMENT OF THYROID CASES

By Hamilton Bailey

Patients with a toxic goitre require the house surgeon's meticulous attention, both in their preparation for operation and their after-treatment

Preliminary Preparation —The patient should be admitted a fortnight before the operation In some cases the preparation can be done at home, but this is usually unwise, if not dangerous There is no need to confine her to bed strictly, on the contrary, it is often advisable for the patient to get up for a short period each day

Lugol's Solution —The preliminary medication by Lugol's solution, introduced by Dr Plummer in 1922, has proved a great advance In an average case 10 min three times a day for ten days are ideal During this time there must be a full intake of easily assimilable carbohydrates and a high fluid intake The patient should have fruit juice and glucose always available, and be encouraged to drink as much as she can If Lugol's solution gives rise to nausea or vomiting, it can be given intravenously in doses of 2 c c daily, well diluted with saline and glucose

As we have said, the preliminary treatment with Lugol's solution has revolutionized thyroid surgery Unfortunately, there are cases of toxic goitre which do not respond to iodine therapy In about 10 per cent of primary thyrotoxicosis, and in about 20 to 30 per cent of toxic adenomas, Lugol's solution has no effect, indeed, it may cause an exacerbation of the symptoms

There is another group which, unfortunately, is quite commonly encountered the patient has already been over iodized I have met with examples where iodine has been given almost continuously for upwards of three years Here successful surgery is robbed of one of its greatest assets, and what to do is often a problem

If the patient is not responding to treatment with Lugol's iodine, it is advisable to consult with a physician Sometimes it is possible to arrange for two or three months' rest without iodine under medical supervision, and to review the advisability of operation at the end of that period In others a 'stage operation' such as polar ligation may be considered to be the best course

On 'Stealing' the Thyroid —Opinions on this procedure differ Unless the patient expresses the wish not to know the day of the operation, I never attempt to 'steal' the thyroid On the contrary, a truthful discussion and an endeavour to inspire the patient with confidence is, I find, better suited to the English temperament For thyroidectomy performed under local anaesthesia this preliminary talk with the patient a week or ten days before adds considerably to the success of the whole procedure

Immediate Preparation of the Patient —Thyroidectomy is best performed in the morning The exact time of the premedication and the nature of the premedication are written up the night before This important pre-operative

measure varies in detail in accordance with the individual surgeon, and no particulars will be described here The house surgeon should see the patient two or three hours before the operation, and if there is an exacerbation of symptoms, particularly an undue elevation in pulse-rate, he should telephone to the surgeon and inform him, for it may be considered advisable to postpone the operation

Immediate Post-operative Treatment—The patient should be propped up in bed in the sitting position The pulse must be watched closely, it is a valuable index of the patient's condition Morphia, ¼ gr, is given as often as necessary

Lugol s solution (1 drachm) in cream is given per rectum soon after the operation Saline and glucose solution is administered either rectally of subcutaneously It is often of the highest importance that the total fluid intake should be in the neighbourhood of 6 pints or more per day

While being a strong believer in the value of continuous intravenous saline in many post operative conditions, I rarely employ it post-operatively in toxic thyroid cases If it is thought advisable to employ intravenous saline, it must be given sparingly, with the full knowledge that the heart's action is impaired, and to overload the circulation with excessive fluid will certainly tax the heart's action still further

POST-OPERATIVE COMPLICATIONS

1 **Hæmorrhage**—This is more frequent after a general anæsthetic The wound must be reopened and the bleeding point ligated if possible, otherwise it is packed and left unsutured A blood transfusion is given if necessary, and secondary closure of the wound can be considered in twenty four to forty-eight hours If local œdema and extravasation of blood is extensive, tracheotomy may be indicated

2 **Tracheitis**—Tracheitis frequently follows a thyroidectomy It is relieved by steam inhalations

3 **Post-operative Crises**—These are fortunately rare, but they still occur, sometimes most unexpectedly I have had a fatal case on the third post-operative day in what was apparently a very large non toxic goitre The house surgeon must be prepared for these crises, and act at once, otherwise the patient will hardly ever recover

It is well to repeat that every house surgeon looking after cases of toxic goitre should have an organization and act at once if signs of a thyroid crisis appear

Symptoms—The pulse is rapid, the temperature high, and the general appearance of the patient gives rise to grave anxiety These symptoms usually commence very suddenly, sometimes as long as four or five days after the operation.

Treatment—Administer intravenously a pint of saline and glucose, to which have been added 50–100 min of Lugol's solution If the temperature is in the region of 103°, ice packs to the limbs are ordered If the temperature is 104° or more, an ice pack to the whole body, except the chest wall, sometimes tides the patient over the crisis The precordial region is a useful situation upon which to apply an ice-pack, but that part of the chest wall overlying the lungs should be avoided

Reopening the wound and packing it lightly with gauze soaked in glycerol is said to be efficacious, for the toxic serum spilled from the cut surface of the thyroid is absorbed into the gauze I have not seen any dramatic result from this procedure

If it is available, an oxygen tent is extremely beneficial Oxygen in some form must be administered without delay

Once the saline is running into a vein, appropriate doses of Lugol's solution can be either injected into the delivery tube or admixed with the saline As soon as the pulse commences to improve, a suitable dose of morphia is prescribed

4 **Mechanical Post-operative Dyspnœa** —When hæmorrhage has been discounted as a cause, the house surgeon must consider the possibility of an injury to the recurrent laryngeal nerves An oxygen tent is of great advantage Intubation of the larynx is advisable Be prepared to perform tracheotomy

As is well known, long-standing adenoparenchymatous goitres are liable to be complicated by a ' scabbard ' trachea Tracheal collapse occurs occasionally soon after thyroidectomy To relieve it the best method is to pass a laryngeal catheter, *if this is feasible Immediate tracheotomy, of course, may be essential*

PARATHYROID TETANY

This is rare If it is suspected by reason of tinglings and numbness of the lips, nose, and extremities, the diagnosis should be confirmed by Trousseau's sign

Trousseau's Sign —A tourniquet is placed around the arm and the pressure raised to 200 millimetres If tetany is present, in five minutes typical contractions of the hand are seen—the so-called ' obstetrician's hand '

The immediate treatment is to administer calcium One or two heaped teaspoonfuls of calcium lactate should be given every hour until the symptoms are controlled, or calcium gluconate, 10 c c of a 10 per cent solution, administered intravenously Parathormone is not essential, and if given must be accompanied by large doses of calcium

When the symptoms are controlled, calcium should be continued for months to come No meat should be allowed, and large quantities of milk are ordered It is convenient to give the calcium in the milk

THYROID CRISES

A patient with a toxic goitre may be admitted in a thyroid crisis (i e , no operation has been performed)

The treatment is much the same as that for a post-operative thyroid crisis If there is copious vomiting, gastric aspiration is advisable In any case, it is advisable to place the patient upon continuous intravenous saline and glucose, which should be given with great care The regulator should be adjusted so that about 30 to 40 drops a minute flow in an average case, and *Lugol's solution* is given in the saline Usually 50 min of Lugol s solution are given once a day, well diluted in the saline

CHAPTER XXVII

THE MANAGEMENT OF SURGICAL THORACIC CASES

By T Holmes Sellors

OXYGEN THERAPY

The administration of oxygen is valuable in the treatment of respiratory and circulatory distress To be effective the alveolar concentration must be high —50 per cent or more A patient who is desperately in need of oxygen is usually restless and resentful, and a good deal of persuasion is needed to make him submit to oxygen therapy Masks, catheters, etc, may be swept off the face and an oxygen tent is often actively resisted When oxygen therapy is likely to be needed the patient should be educated in its use *before* it is necessary

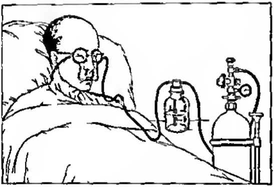


Fig 194 —Tudor Edwards's spectacle carrier for the intranasal administration of oxygen.

The variety of methods for administering oxygen shows that the ideal has yet to be found *The crude arrangement of a tube and funnel blowing a whiff of oxygen across the patient's face is futile*

Nasal Catheters — Fine catheters introduced into each nostril and supported on a head band or empty spectacle frame (Fig 194) are fairly well tolerated The oxygen should be bubbled through water so as to maintain adequate humidity A flow of 3 litres per minute raises the alveolar O_2 to 27 per cent, but a higher rate of flow is not usually tolerated

Face Masks — In emergency an ordinary nitrous-oxide bag and face mask attached to an oxygen cylinder is effective The expiratory valve can be so adjusted that the patient breathes freely without resistance into the bag

Marriott has suggested that in an emergency the standard gas mask or respirator can be utilized by fitting a football bladder over the metal canister (Fig 195) In the absence of a flowmeter the bladder should be kept just distended so as not to collapse completely during inspiration

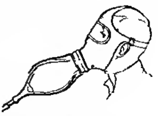


Fig 195 —A gas mask adapted as an oxygen mask. (*Marriott*)

The B L B Mask (Boothby, Lovelace and Bulbulian) is the most effective appliance for oxygen administration This mask leaves the patient's mouth free for eating and spitting though clearly, if a high oxygen concentration is to be

maintained he should not breathe through the mouth This apparatus (*Fig* 196) is provided with three port-holes which can be opened to admit air With

Fig 196—*The B L B mask Note tubes leading from the nasal mask round the mouth to the reservoir bag* The metal ports can also be seen Flowmeter is on the bedside table

all three open and a flow of 4 litres per minute the alveolar concentration reaches 56 per cent, while with 6 litres per minute with all closed the concentration rises to 87 per cent A flowmeter should be employed, but its absence does not preclude the use of the mask The B L B mask is economical, another great advantage over the oxygen tent is that the patient is accessible

The Argyll Campbell Mask is a more improvised and less expensive form Here a transparent face-piece is placed over the face and moulded to fit it The oxygen inlet is at the top of the mask.

Rose and Sellors improvise a mask out of a used X-ray film The apparatus fits over the chin and is open at the top (*Fig* 197) The oxygen inlet is at the bottom It will be realized that this is only an emergency provision

Fig 197—Mask improvised out of a used X ray film.

Oxygen Tents—The main feature of the tent is that the patient can live in an atmosphere of oxygen with an easily adjusted concentration There is no restraint of the movements of the head by a mask, but patients often complain of stuffiness and claustrophobia To overcome this to some extent the temperature of the circulating oxygen can be lowered by running half of it (about 3 litres min) through an ice-box The oxygen flow from large 100-cu-ft cylinders is controlled by a reducing valve which leads in some apparatuses to the two outflow tubes In addition there is an emergency flushing valve The average consumption is about 100 cubic feet in six to eight hours to maintain 50 per cent concentration Carbon dioxide is absorbed by soda lime

The tent consists of a bell of light, air-tight material with transparent panels The loose aprons are tucked in with the bedclothes (*Fig* 198) Examination of the patient without removing the tent is not easy Consequently, at any rate for adult surgical cases, the B L B mask is more suitable

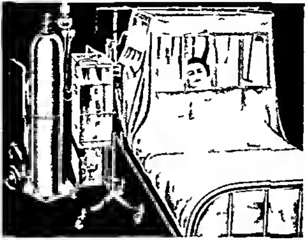


Fig 198 —An oxygen tent. The loose aprons are tucked in with the bedclothes

Control and estimation of the oxygen concentration is made from time to time by simple gas analysis apparatus (Poulton Shackle) The details of this and precise instructions for managing the tent are supplied with the apparatus or arranged by the valuable hire services that are available in most large towns

Warning —All oxygen administration is open to the grave risk of explosion and fire, in many of these explosions the patient has perished All forms of spark, fire, or combustibles must be kept away

The following are examples of what must be avoided Smoking, matches, electric light and power switches, night lights, sparking toys, static sparks from combing the hair vigorously, grease on the cylinder head of the oxygen tubes, gas rings, gas lighting

ASPIRATION OF THE CHEST

Diagnostic Aspiration.—Careful examination suggests the likely spot for exploration

Injecting Local Anæsthesia —A preliminary sedative should be given. At the selected point local anæsthesia (1 per cent novocain) is injected First, with a fine needle, a subcutaneous wheal is raised, then, with a somewhat larger needle, the deeper tissues are infiltrated, in all about 10 c c of the solution is injected Particular attention is paid to the intercostal space, so that by diffusion the nerve in that segment will be anæsthetized When difficulty in locating purulent fluid is anticipated, a good practice is to make a series of intercostal injections well towards the spine This will render a wide segmental area insensitive

Technique —In performing aspiration there is no necessity to employ a needle of large bore, but it should be at least 2½ in long The syringe to which it is connected should contain a few cubic centimetres of air or fluid (the local

anæsthetic solution is handy) so that when the pull on the plunger is released the piston cannot fly against the base of the syringe and break the barrel

As the needle is advanced towards the pleura it is possible to gauge the thickness of that membrane, which normally offers no more resistance than a sheet of notepaper A thick pleura gives a rubber-like or even woody sensation, and its thickness can often be judged accurately

Findings —

Gas is withdrawn If, instead of fluid, aspirated air appears in the syringe, it must be due to one of the three following (1) A leak in the needle-syringe outfit, (2) Puncture of the lung, (3) Gas from the empyema cavity —the stink of gas from an empyema leaves no doubt as to its origin

Fig 199 —The site of a successful puncture is ringed with dye and the depth at which pus was located is recorded in the notes

Blood is withdrawn Lung puncture is usually accompanied by a little blood, making a froth The arrival of pure blood into the syringe may be due to several causes Intercostal vessel injury and entry into a hæmothorax lead to a steady flow of blood into the barrel These two conditions can be differentiated by assessing where the needle point lies Liver puncture usually results in some fragments of brownish liver substance being withdrawn, they can be demonstrated by evacuating the contents of the syringe and needle on to dry gauze

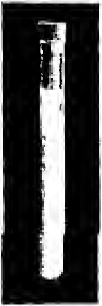


Fig 200 —Thick pus in aspirated fluid after standing overnight.

Purulent fluid is withdrawn It is highly important to mark the point of a successful aspiration The skin about the puncture should be ringed with a small circle of dye (methylene blue) (*Fig* 199) and the depth of the needle recorded One specimen should be sent to the laboratory for examination Another specimen should be retained by the clinician and, unless operation is indicated urgently, left to settle overnight (*Fig* 200) The amount of deposit will give some indication of the viscosity or density of the pus and help in deciding the course of action

Pus is suspected, but not located In a difficult case, in order to cover a wide area it is useful to make the first puncture at right angles to the chest wall and then to work systematically in a radiating fashion until the whole of the suspected area has been explored If pus is not found the puncture must be repeated elsewhere Providing the area is properly anæsthetized four to six punctures can be carried out without unduly distressing the patient Failure to find pus does not imply that it will not be discovered on the next or a few days later If clinical findings and radiography point to the existence of an empyema, the procedure of diagnostic aspiration must

be repeated until pus is either found or proved by an exhaustive process of exclusion to be absent.

TREATMENT OF EMPYEMA

Sulphanilamide preparations undoubtedly have saved many lives from the ravages of the hæmolytic streptococcus, and sulphapyridine (Dagenan or M & B 693) is apparently specific in its action against the pneumococcus A short intensive course of M & B 693 should be given in all cases of proven pneumococcal empyema Sulphathiazole should also be mentioned, though its full value is not yet finally assessed

Deciding upon the Method to be Employed to Remove the Pus—Thin fluid full of organisms calls for removal less urgently than thick pus, but this same thin fluid may demand immediate removal on account of its pressure effects In selected cases intercostal drainage is preferable to repeated aspiration

THERAPEUTIC ASPIRATION

When a large collection of fluid has to be evacuated it is convenient to attach a T shaped tap as shown in *Fig* 201 between the syringe and the needle The tap avoids disturbing the needle point, a mishap liable to occur when the syringe is repeatedly detached for emptying Special types of syringe, such as the Dieulafoy, and the Potain aspirator, may be employed.

Fig 201—A two-way syringe—a valuable instrument when a large collection of fluid has to be evacuated.

After evacuating some ounces of fluid from an empyema it is not unusual for the patient to cough and complain of discomfort, which is due to the sudden removal of fluid. Immediate relief can be obtained by allowing a few cubic centimetres of air to enter By judicious staging of air replacement, large collections of pus can be evacuated completely

INTERCOSTAL DRAINAGE

Intercostal drainage is easily performed and can be used in empyema where thin pus is forming rapidly It can be employed up to the time that pus becomes thick or fibrin flakes block the lumen of the tube Intercostal drainage is, therefore, valuable only in the early stages of treatment, and it cannot be regarded as an alternative to rib resection Very few empyemata are cured without recourse to rib resection.

For intercostal drainage three sizes of cannulæ are commonly used Catheters of the self-retaining Malecot type must be selected to fit their respective cannulæ The skin over the anæsthetized area is nicked with a small scalpel or tenotome Holding the incision steady over the interspace, the trocar and cannula are thrust into the pleural cavity, taking great care to 'guard' the shaft so that too deep an entry is avoided The trocar is withdrawn and the opening of the cannula is occluded with a finger until the catheter on its introducer can be inserted The cannula is then removed, being careful to avoid pulling the catheter out at the same time The tube is adjusted so that the self-retaining expansion just touches the parietal aspect of the pleura A fine stitch is inserted to anchor the tube to the skin

If necessary, it is possible for this operation to be performed in the patient's bed without much more difficulty or mess than an ordinary aspiration

A warning should again be made against too great enthusiasm in persisting with this form of drainage In adults 5–10 days is the maximum time for intercostal drainage to remain effective, after this period the tube tends to become blocked with flakes of fibrin or thick pus and its value is lost

RIB RESECTION

Removal of a short length of rib over an empyema cavity has two main advantages—the cavity can be explored and a wide drainage tube can be inserted There is no constant site for this operation, which is best performed under local anæsthesia Careful localization with the aspirating needle must determine the lowest and most posterior point of the empyema cavity, so that the contents will be evacuated by the action of gravity and undrained pools avoided The most usual place in which drainage is required is about the 8th or 9th rib at the posterior angle just outside the erector spinæ mass A vertical incision (*Fig* 202) allows access to more than one rib in case the original localization by needle has not been quite accurate After removing 2 to 2½ in of rib, the empyema is opened into through the rib bed and pus flows out The cavity should be explored with the finger to remove any fibrin or 'lymph' mass, and at the same time to assess its outline and check the accuracy of the position of the tube A large flanged tube is used for drainage, the flange preventing accidental pulling out of the tube and ensuring that it lies close to the inside of the chest wall and does not project into the cavity, where it might injure expanding lung A flanged tube is not essential and a wide bore tube with one side eye will serve the purpose well, but its wall must be sufficiently stiff to prevent kinking Careful suture of muscles and skin round the tube makes an airtight junction, over which a small dressing can be applied The tube is connected to a 'closed' drainage system as soon as the patient is returned to bed

Fig 202 —A vertical incision allows access to more than one rib and is recommended in case the original localization by the needle is inaccurate

'Closed' Drainage —One of the factors in the undoubtedly improved results from the treatment of empyema during the past decade is the use of 'closed drainage in cases where the lung is collapsed If the skin and soft tissues are sutured closely around the tube and the drainage system is maintained closed by a water-seal (*Fig* 203), the sub-atmospheric pressure of the pleura is imitated and the lung encouraged to expand

Maintenance of the 'Closed' System —In fitting up a closed drainage system it must be remembered that its efficiency is dependent on its narrowest part A typical apparatus (*Fig* 204) consists of the drainage tube (A), a glass connexion (B), a long length of rubber tubing (C) leading to the floor, where it enters the collecting bottle via a straight length of glass tubing (D), the end of which dips below the surface of fluid in the bottle If there is no leakage between the empyema cavity and the bottle, the sub atmospheric pressure in the pleura causes the water to rise up the glass tubing (D) With each act of respiration this level oscillates and the violence of a cough will blow the water out of the tube and possibly make bubbles in the bottle before the level ascends again to X

So long as pus descends into the bottle and the fluid level swings freely in the tube, the system is functioning well

Failures in the System—Blocking at some part or other by pus or fibrin flakes is common and is recognized by absence of swing in the tube (D) The most likely site is at the glass connexion (B), which is invariably the narrowest part of the system Momentary disconnexion for cleaning or judicious 'milking'

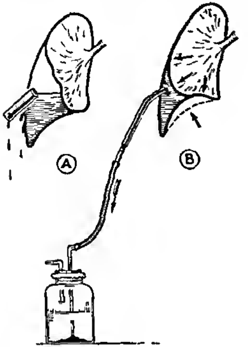


Fig 203—Principles of open and closed drainage contrasted. A Open B Closed

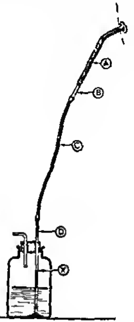


Fig 204—Diagram illustrating the maintenance of the closed drainage system. (For description see text.)

downwards of the rubber tubing (C) may affect a clearance The internal opening of the drainage tube (A) may become occluded by expanding lung or a mass of fibrin and leakage of pus along the side of the tube will confirm the site of the obstruction Simple irrigation may suffice to free the drainage, but in obstinate cases it is of help to cut the tube short and explore gently with a soft bougie and pair of forceps Another cause of error, easily remedied, is a kink or sagging loop in the tube (C)

Free bubbling into the bottle suggests a leak in one of three places—the apparatus between the empyema cavity and the outer air, or between the empyema and the bronchi Leakage at the skin tube junction is fairly common about the 8th to 10th or 12th day, but as scar tissue forms the tube is gripped more firmly and sealed again

For the comfort of the patient it is important to see that drag or pull on the tube is avoided Most tubes lie easily between pillows and pass through the head of the bed, and strapping can be used to take some of the strain of the drainage tube on to the skin of the back Safety pins around the long tubing

(C) (not through it) into sheets or mattress help further in relieving the pull, and patients when moving their position readily learn to steady the tubing during the process

Irrigation of an Empyema Cavity—The value of irrigating an empyema cavity is possibly more dependent on its mechanical than disinfectant merit The use of a dilute hypochlorite solution is held to dissolve deposits of fibrin Merthiolate (1–5000) in staphylococcal cases and 1 per cent acetic acid when *B pyocyaneus* is present are also of use If irrigations are to be employed there is one definite proviso that must be established before they are attempted—to wit, the absence of a bronchopleural fistula To pour fluid into a cavity which opens into the air-passages is to invite an uncontrollable fit of coughing and possibly death from drowning.

Test for bronchopleural fistula A few cubic centimetres of a harmless dye such as dilute methylene blue are injected into the cavity If the patient coughs up sputum stained blue, it is obvious that a pleurobronchial communication is present Absence of dye from the sputum for twenty-four hours indicates that it is safe to proceed with irrigation When irrigation is practised regularly, it can be made to serve another purpose, which is encouraging to both the patient and his nurse—that is, measuring the capacity of the empyema cavity by filling it to overflow every few days and charting the volume

The Management of an Empyema Drainage Tube.—

Chronic empyema is a most disabling condition which entails months of continuous treatment In nearly all cases it can be prevented by a proper understanding and careful management of the drainage tube

Closed drainage is neither necessary nor desirable through all stages of empyema treatment When the pleural abscess has become localized effectively

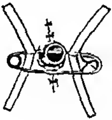


Fig 205.—Method of anchoring an open empyema drainage tube

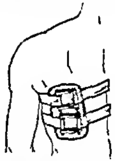


Fig 206—Learmonth's method of corsettage is particularly suitable for maintaining an empyema dressing in position.

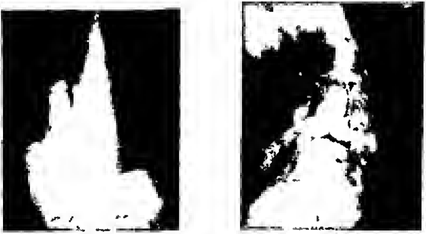
and the walls of the cavity are relatively firm, the closed system can give place to 'open' tube drainage

The empyema drainage tube is cut short practically flush with the chest wall, it must not project enough to be pressed upon by dressings Attention is also directed to the length and position of the tube within the thorax, it must not press upon the lung lest ulceration and hæmorrhage occur When a large cavity is being drained it suffices to see that the tube is of sufficient dimensions and that lateral openings are so placed that pocketing cannot occur

Having attended to these important details, we are in a position to proceed with the routine dressing

A safety-pin is fastened to the drainage tube in order to obviate it slipping into the chest It is prevented from coming out of the wound by anchoring the safety-pin to the chest wall with a narrow adhesive tape (*Fig* 205) A piece of vaseline gauze can be placed beneath the pin around the tube, and the whole is covered by light dressings Circumferential binders do not always prevent the dressing from slipping, and they tend to restrict respiratory excursions Corsettage (*Fig* 206) is the method which should be employed

Contrast Radiographs—As it is impossible to determine the progress of healing from outward appearances and straight radiographs, and as it is essential to know the size and shape of the cavity, especially during the later stages of treatment, contrast radiographs at regular intervals are indispensable Having



A B

Fig 207—Contrast radiograph of an empyema cavity (pleurogram) A, Antero-posterior view B Lateral view

first excluded the presence of a gross fistula, opaque oil (neo-hydriol or lipiodol) is allowed to gravitate into the cavity, the patient lying with the drainage opening uppermost Radiographs in the antero-posterior and lateral planes are taken, it being particularly important not to ignore the lateral view (*Fig* 207) In this way a good estimation of the cavity can be gained and compared as successive films are taken at, say, weekly intervals When a fistula allows the injected oil to run too freely into the bronchi, loose packing of the empyema cavity with gauze soaked in the opaque oil overcomes this difficulty As a point of economy, it should be realized that to fill a big space with either of the oils mentioned is very expensive, so dilution of the opaque oil with paraffin should be considered The radiological result will not be so emphatic, but even with considerable dilution an adequate contrast film can be obtained

When should the Drainage Tube be Removed ?—It is clearly wrong to take out the tube while a large suppurating cavity still requires drainage Temptation to remove the tube must be firmly resisted when the discharge has almost ceased and the patient's condition is obviously good Healing cannot be

guaranteed until the whole empyema space has been obliterated, and this implies that a tube must remain in place until the capacity of the cavity is less than 5 c c As the cavity closes the tube must be shortened appropriately until the empyema is virtually nothing more than a chest-wall sinus

It is safe to leave the original tube in situ right up to the end, but it may add to the patient's comfort to substitute a somewhat smaller one when the process of healing is well advanced *The practice of removing a tube to have it washed and boiled each day is to be deplored*

If the tube is frequently removed, invariably there comes a time when the contraction of the opening prevents the original tube being re inserted without pain and a smaller tube is usually placed in the sinus, at later dates the process is repeated until the external opening is totally inadequate This error in management is still too frequent

Factors Requiring Special Consideration—As a result of the pleurograms and other data, it will become evident that certain cases require special measures if chronicity is to be avoided

Mechanically Imperfect Drainage—When confronted with a case where the external opening has been allowed to contract prematurely, steps must be taken to stretch it sufficiently to allow the re-insertion of a tube of adequate calibre by (*a*) The passage of graduated bougies, or, preferably, (*b*) The insertion of a laminaria sea-tangle tent for twenty-four hours, but care must be taken to have a string attached to the tent for purposes of withdrawal When these measures fail the cause of the external narrowing is usually due to osseous regeneration, and operative measures to ensure a sufficiently large opening are required

With a long, narrow track it is important to be sure that the tube reaches almost (to within ½ in) of the extremity of the cavity The length of this track can be estimated by soft bougies or, more accurately, by inserting a tube which is radio-opaque (barium-loaded tubing) and screening the patient

In the case of an hour-glass empyema cavity the constriction must be dilated carefully until a tube of adequate size can be passed into the bulb beyond the stricture

It is only by contrast radiographs that unsuspected pockets and tracks can be visualized If the gravity drainage of these is inadequate, further operative treatment is essential, otherwise the infection may be perpetuated and ultimate healing postponed indefinitely

Offensive Discharge or continuing profuse pus are indications for a complete investigation If the contrast radiographs show that the cavity is not draining at its most dependent point the patient must either be placed in such a position that the opening is able to drain with the aid of gravity, or, if this is ineffective, operative measures must be considered

Persistent Pain—If other factors have been excluded intercostal neuritis may be the cause This often responds temporarily to injection of novocain, and in more resistant cases to alcohol injection or resection of the intercostal nerve

Breathing Exercises—The importance of aiding re-expansion of the lungs by means of breathing exercises cannot be over estimated Blowing water from one bottle to another is the traditional procedure Unfortunately, the indispensable effort in expansion is not expiratory but inspiratory Exercises must, therefore, be directed towards improving the tone of the inspiratory mechanism, i e, the musculature of the lower chest and diaphragm MacMahon's exercises are unsurpassed Inspiration is made against pressure applied to the abdominal wall by the hands of a masseur (*Fig* 208) The exercise, repeated five or six times at each session, should commence within a few days of the establishment

of drainage, and must be continued with increasing muscular effort until and after the empyema has healed It is of little value to practise it only during the

Fig 208 —Inspiration is made against pressure applied to the abdominal wall

visit of the masseur or doctor, the patient must be trained to carry out the exercise himself for hours, rather than minutes, a day

INSTRUCTIONS FOR BREATHING EXERCISES*

Continual practice and effort are both essential if the expansion of the chest is to be improved

Set aside fixed periods each day for the exercises Do not become slack or forget them

IMPORTANT POINTS

1 Think and concentrate on expanding the chest in the direction required.

2 Apply pressure carefully over the part to be exercised. Place the flat of the hand well over the area and press firmly with the palm.

3 Breathe in quietly through the nose, breathe out completely with the mouth slightly open.

4 Do each exercise 18 to 24 times in groups of 6, with a few moments rest between each group

Side Expansion of Lower Ribs (*Fig* 209)—

Lie with the knees bent, or sit with the back well supported.

Place the hands well round the sides of the lower ribs

Breathe in and expand the ribs out against the pressure of the hands

Relax the pressure at the height of inspiration so as to obtain the fullest expansion

Breathe out fully and at the end of the act press with the hands so as to expel as much air from the chest as possible

Fig 209

* These instructions were compiled with the help of Miss Read, Harefield Sanatorium

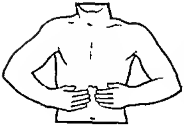


Fig 210

Diaphragmatic Movement (*Fig* 210) —
Lie as above
Place the hands over the front of the lower ribs so that the finger tips are nearly touching
Keep the upper part of the chest still and breathe in
Expand firmly round the front part of the waist under the hands
Breathe out slowly, first sinking the chest and then pulling in the upper part of the abdomen *powerfully*

Expansion of the Lower Chest on One Side (*Fig* 211) —
Place the hand over the area to be exercised (use the other hand to check movement on the opposite side)
Breathe in, expanding the ribs outwards against the pressure of the hand
Concentrate on making the effort only over the required area
Release the pressure in the final stage so that the height *of expansion is not* held back
Breathe out and help the finish with pressure of the hand

Fig 211

Expansion of the Upper Chest on One Side (*Fig* 211) —
Place the hand over the upper part of the chest with the fingers just below the collar bone Use the right hand for the left chest and vice versa
Breathe in, expanding the chest upwards and forwards against the pressure of the hand Keep the shoulders down and try to drive upper ribs up under the collar bone
Breathe out and drop the upper part of the chest Press with the fingers at the end

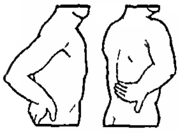


Fig 212

Backwards Expansion of Lower Ribs on One Side only (*Fig* 212) —
Sit slightly bent forwards
Place the hand as far round on the back as possible—the thumb will be pointing downwards
Breathe in and expand the ribs backwards against the firm pressure of the hand Slacken the pressure at the height of inspiration.
Breathe out and relax the lower ribs Straighten the back and spine slightly as the final pressure is given.

CONCENTRATE AND PERSIST

SUCTION DRAINAGE

When breathing exercises fail to produce the lung expansion which is anticipated, the closed water-seal method must be assumed to be inadequate Direct mechanical suction by electric or water pump is then sometimes helpful An intervening tap with a manometer and automatic release, such as is found on a Roberts' bottle, prevents too high a degree of suction—2–5 mm Hg is the maximum for the average case Higher figures may lead to fistula formation Suction may be maintained for many weeks if necessary

POSTURAL DRAINAGE

Normally the action of bronchial cilia and coughing remove secretions from the air tubes and maintain them free from obstruction In certain conditions the infective process causes dilatations and cavities which cannot be properly cleared by coughing

Postural drainage means the placing of the patient in such a position that the affected part of the bronchial tree can empty under the action of gravity This is sometimes translated as getting the patient to lean over the edge of the bed for a few moments each day—an almost useless state of affairs

The actual position to be adopted has to be worked out carefully for each individual case, and the correct position of that case must be maintained for several hours at a time

A brief description of the anatomy of the bronchi may help towards a proper appreciation of the position to be adopted In the first place it should be realized that both sides have a similar distribution and that the 'lingula' process of the left upper lobe is the equivalent of a middle lobe Both lungs can, therefore, be discussed together

The *upper lobe* bronchus takes an upward course and gives off branches which describe the areas that they supply, e g , dorsal and ventral apical, axillary, and pectoral Drainage will be best with the patient in the *upright* position (*Fig* 213), leaning slightly away from the diseased side

The *middle lobe* bronchus leaves the main stem on the anterior aspect and runs forwards and downwards There are two main branches, an upper and lower Drainage is effected by the patient lying *flat on the back* (*Fig* 214)

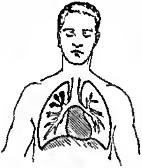


Fig 213 —The upper lobe is drained when the upright position is adopted

Fig 214 —The middle lobe is drained effectively when the patient lies on the back.

The lower lobe main bronchus is directed downwards, with a slight outward and backward inclination. It gives off a series of large trunks which supply the base of the lung and are the tubes most commonly affected in bronchiectasis As these branches lie in front of the main plane of the bronchus, they are referred to as ventral branches, in distinction to less significant dorsal stems, of which the first is the most clearly defined. Drainage is achieved by the patient lying *head downwards*

The head down position is the one most commonly required, and the most simple way of doing this is to raise the foot of the bed on high blocks However, it is difficult to prevent the patient from sliding downwards by this method The solution is to lay the patient on the abdomen and to place a wedge of pillows or a chair at the centre of the bed (under the mattress) so that the patient is balanced over the wedge with buttocks in the air (*Fig* 215)

A specially designed posture bed (Nelson's type) enables a wedge to be raised and lowered at will without moving the patient An easily constructed apparatus is illustrated in *Fig* 215 , a similar frame in wood can be made at a low cost by any carpenter The centre support must be firm and of a height not less than from 18 to 20 in. If this can be made to detach by a series of bolts and the inclined planes made as hinged flaps, storage is greatly facilitated

Great emphasis must be laid on the importance of persistence with this form of treatment—it must be a question of hours each day, and with a little practice patients can be induced to sleep upside down Anything under 6 or 8 hours in the 24 does not give postural drainage a chance of being effective

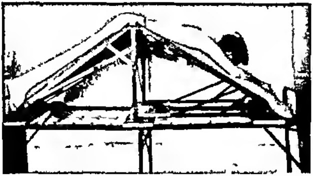


Fig 215 —Improvised postural wedge for drainage of a lower lobe The central prop should be 8 to 20 in. high

CHAPTER XXVIII

THE MANAGEMENT OF GASTRIC CASES

By Hamilton Bailey

Pre-operative Treatment —As a preliminary measure for operations upon the stomach, gastric aspiration and lavage are indicated, particularly in the case of pyloric stenosis It is a good practice to send the patient to the operating theatre with the tube in position

If the operation is conducted under local anæsthesia and the patient experiences nausea during the operation, the stomach can be emptied The tube is left in position after the operation, whether it is partial gastrectomy or gastrojejunostomy

Patients with gastric lesions are very prone to post-operative chest complications, and it is most desirable that the house surgeon should pay especial attention to an examination of the lungs before a patient undergoes an operation upon the stomach

Fractional Test-meal —*See* Chapter LXVI

Aspiration of the Stomach —*See* p 97

Feeding after Gastric Operations —The post-operative regime varies somewhat in different hospitals The following scheme will be found to be satisfactory

First Twenty-four Hours —Nil by mouth Rectal saline with glucose continuously or ℥vj four hourly Oral hygiene Frequent mouth washes

Second Day —Sterile water by mouth ℥j hourly * Rectal saline with glucose six-hourly

Third Day —Sterile water ℥ij, alternating with Benger's or Allenburys Food ℥ij two-hourly Rectal saline eight hourly

Fourth Day —Sterile water ℥iij, alternating with Benger's Food ℥iij three-hourly Glycerol enema

Fifth Day —Sterile water ℥iv, alternating with Benger's Food ℥iv, four hourly

Sixth Day —Very weak tea (strained) Custard, jelly, water *ad lib*

Seventh Day —Pounded fish Wafer of bread and butter—no crust

Eighth Day —Minced chicken

The diet is then gradually increased

VOMITING AFTER OPERATIONS UPON THE STOMACH

During the first forty-eight hours after operations upon the stomach, a proportion of patients bring up bile in varying quantities In order that we may be in a position to judge whether the stoma is functioning, orders are given that the vomitus is to be measured and recorded on a separate slip—a vomit chart

A better practice is to pass a gastric aspiration tube via the nose as a routine Instead of a patient vomiting, gentle aspiration is carried out if he even feels sick. Feeds must be stopped forthwith and fluid supplied by another route After twenty four hours, feeding is commenced with the tube still in situ If at the end of this period there has been no tendency to vomiting, the tube is removed

* Feeds must be stopped for a time if the patient vomits

It is after forty-eight hours, if vomiting commences or large quantities of bile are recovered by gastric aspiration, that a serious view of the case must be taken Obviously the stoma is not functioning—it is very suspicious of a vicious circle

In health the liver secretes about 50 oz of bile in twenty-four hours, and by the chart *one can work out approximately how much is passing through the* stoma In order to make these calculations the method of charting described above is absolutely essential *If* by the vomit chart you are not satisfied that at least half the bile is passing through the stoma, request an urgent consultation with the surgeon

POST-OPERATIVE HÆMATEMESIS

1 Pass a gastric aspiration tube and wash out the stomach gently with 2 per cent bicarbonate of soda in normal saline at 120° F, and into the last portion of the wash add a drachm of 1–1000 adrenaline

2 Have the pulse recorded hourly on a separate piece of paper pinned on the chart

3 Give morphia ¼ gr subcutaneously

4 Get the blood grouped and arrange for a suitable donor to hold himself in readiness

It should be needless to add that the surgeon must be summoned at the earliest possible moment

Remote Severe Post operative Melæna —Severe melæna sometimes occurs a week to ten days or more after gastro-enterostomy The particular type of case this uncommon complication seems to favour is duodenal ulcer with stenosis When hæmorrhage occurs so remotely, it is unlikely that the bleeding is coming from the anastomosis—it is the ulcer which is bleeding This type of hæmorrhage is liable to be overlooked, especially as the patient has been doing well up to the time of its onset

Blood transfusion, and arrangements for re transfusion if necessary, is the treatment recommended

Duodenal Fistula Following Gastric Operations —*See* p 199

Acute Dilatation of the Stomach —*See* p 197

HÆMATEMESIS (NON-POST-OPERATIVE)

Cases of hæmatemesis are usually, but not invariably, admitted to the medical side It is a good practice to have the blood grouped at the first available opportunity, for blood transfusion may become necessary urgently It is for cases of hæmatemesis that drip transfusion (*see* p 89) is indicated specially

During recent years the conservative treatment of hæmatemesis has undergone a radical change *The patient is made to sit up in the low Fowler's position*, and is fed instead of being starved The following is a résumé of the modern treatment —

Diet —

1st day.—Three pints of milk with three beaten eggs added are allowed Eight ounces of this mixture is given three-hourly If the patient is thirsty the mixture may be given even *immediately after the hæmatemesis* On the other hand, *if the patient* does not wish to have the milk it is not forced upon him Water may be given instead

2nd day —As on the first day

3rd day —If no further hæmatemesis, allow jelly, eggs, and custard

Subsequently —The usual medical treatment for peptic ulcer

Drugs —A restless, anxious patient is given ¼ gr morphia A teaspoonful of alkaline powder is given four times a day, and a mixture containing 20 gr of iron and ammonium citrate t d s

CHAPTER XXIX

THE MANAGEMENT OF GALL-BLADDER AND PANCREATIC CASES

By Hamilton Bailey

Gall-stone colic should be treated by hot fomentations to the upper abdomen and an injection of morphia Actually, morphia does not relieve the pain as often as might be expected In severe cases of gall stone colic it is worth trying the injection of an ampoule of 10 per cent gluconogalactogluconate, which relaxes smooth musculature

Acute Cholecystitis —

Delayed Treatment —The delayed treatment of acute cholecystitis stipulates an accurate and confident diagnosis, but there is no question regarding the extremely good results accruing from this treatment When the attack has subsided, cholecystectomy is performed

The details of treatment are very similar to those of the Ochsner-Sherren treatment of acute appendicitis (*see* p 194) The patient is placed in Fowler's position Water only is given by mouth for two or three days After this time a fluid diet is substituted until all the symptoms have subsided For so long as the condition of the patient gives rise to anxiety, the temperature and pulse are recorded every two hours Hot fomentations or a hot bottle placed on the upper abdomen help to relieve the pain No morphia or its substitutes are given for the first twenty four hours unless the diagnosis is absolutely undeniable

Gall-stones and Chronic Cholecystitis —

Pre operative Treatment —Providing the patient has not been jaundiced recently, and has not had an attack of biliary colic for a week or more, there is rarely need for more than ordinary pre operative care It is a good practice, however, to insist on a high intake of carbohydrates twenty-four or forty-eight hours before the operation Glucose may be prescribed conveniently in the form of barley sugar

Post operative Treatment —If, as is not infrequently the case, the patient is obese, special consideration should be given to the prevention of pulmonary complications (*see* Chapter XXIV)

Drainage Tubes —In standard cholecystectomy a drainage tube is inserted For the first forty eight hours there is a blood stained exudate, usually dark-coloured portal blood from the bed of the gall-bladder in the liver Bright red blood suggests the possibility that the ligature on the cystic artery has slipped and requires the house surgeon's watchful attention

After forty eight hours, and sometimes before, a varying amount of bile escapes

There should be no hurry in removing the tube, unlike tubes situated in the lower abdomen, the danger of coils of intestine becoming adherent to the tract is almost negligible If bile is escaping from the wound, it is better to leave the tube in too long than not long enough, although of course the tube should be

shortened Occasionally the flow of bile is so profuse that doubt is entertained as to the integrity of the common bile-duct In such cases the stools are examined daily If the stool is putty coloured, a specimen is sent to the laboratory for examination for the presence of bile

In all cases of biliary fistula the skin in the immediate vicinity of the wound should be protected by an oily dressing

Thorek's Operation—After cholecystectomy by Thorek's method a strip of the gall-bladder is left attached to the liver The mucosa of the strip is coagulated with the diathermy After suitably patching the area with a piece of detached round ligament, the abdomen is closed without drainage

After all operations on the biliary tract, during early convalescence it is a rational procedure to prescribe a biliary antiseptic such as Felamine, which contains cholic acid and urotropine, the dose is one tablet t d s, p.c, with a copious draught of water

Records—A simple diagram indicating the position of stones and other pathological features of the gall bladder and bile-ducts is more valuable as a permanent record than a long description (*Fig* 216)

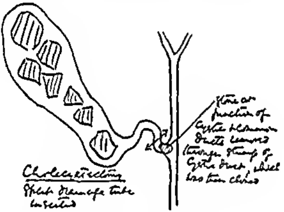


Fig 216—Facsimile of a record of the operation of cholecystectomy

Obstruction to the Common Bile-duct—

Pre-operative Treatment—Jaundiced patients require extremely careful pre-operative preparation The well-known tendency for jaundiced patients to bleed should be sufficient warning for a thoughtful house surgeon to get the patient grouped for a possible transfusion without being told to do so There is much also to be said for prescribing teaspoonful doses of powdered calcium lactate dissolved in hot water, or calcium gluconate in similar doses, t d s, for several days before the operation The ingestion of vitamin K, with or without the addition of bile-salts, has proved a most valuable advance in allaying the tendency to hæmorrhage in jaundiced patients Vitamin K should be given several days before, and continued for several days after, the operation

The remarks concerning the administration of glucose pre-operatively for operations on the biliary tract are doubly important in this instance, for the liver cells are choked with bile Glucose should be given by mouth and also by rectum Unless the obstruction has been relieved, it is unwise to give intravenous saline

or a large blood transfusion to a patient suffering from obstructive jaundice Intravenous saline sweeps the bile pigments to the kidneys and the tubules become choked Anuria is liable to develop It is therefore necessary among other things to observe and record the urinary output of the deeply jaundiced patient

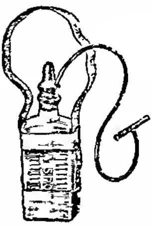


Fig 217 —A medicine bottle a rubber teat and adhesive plaster make a convenient sterile receptacle for bile (*After H I Cameron*)

Post-operative Treatment the Management of a Cholecystostomy Tube —The tube is led into a sterile bottle (*Fig* 217) In profoundly jaundiced patients the liver function is at a low ebb and the flow of bile during the first forty eight hours is often discouraging If the bile is very thick the house surgeon can very gently irrigate the interior of the gall bladder through the tube, using not more than an ounce or two of saline To encourage a flow of bile intravenous saline can be given very cautiously A cholecystostomy tube should never be removed early, indeed, in almost every instance it is best to cut the retaining stitch on the tenth day and allow the tube to be extruded spontaneously

Management of a Tube in the Common Bile-duct —A tube in the common bile-duct should be the house surgeon's special care He should give instructions that it is to be left in and that he himself will remove it when the time comes A tube often employed is a T-shaped one (*Figs* 218, 219), and it is necessary to realize that a track around the tube shutting it off from the peritoneum must form before any thought of removing the tube is entertained If a tube in the common duct is removed too early, of necessity bile leaks into the general peritoneal cavity

When a T-tube has been used to drain the common duct, after a week it may be clamped for an hour or two, in order to ascertain if the bile will flow into the

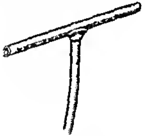


Fig 218 —T-tube for draining the common bile-duct.

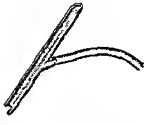


Fig 219 —Maingot's T tube for draining the common bile-duct.

duodenum If pain follows or bile drains around the tube, it is certain that the time for removal of the tube is not at hand Before removing a tube in the common bile-duct it is very desirable to know if the path for the bile from the liver to the duodenum is free This can be demonstrated by injecting lipiodol down the tube and having an X ray picture taken (*Fig* 220) After fourteen days have elapsed, one can be sure that protective adhesions have formed If in addition it has been demonstrated radiologically that the path to the duodenum is

patent, the T-shaped tube can be removed by a steady pull with every confidence

Feeding of Bile—In patients with a total biliary fistula the advisability of collecting the bile and returning at least some of it to the patient should be considered In patients whose general condition is good two or three ounces of bile can be mixed with fruit juice and given at frequent intervals Another method is to dilute the bile with saline and to administer it per *rectum* A third method, which is especially indicated in very ill patients, is to pass a gastric aspiration tube and to administer the bile at intervals during the day into the stomach

Fig 220—Radiograph after lipiodol has been injected down a T tube lying in the common bile duct showing that the pathway to the duodenum is unobstructed (*W B Gabriel*)

Stone Impacted in the Common Bile-duct Pribram's Method of Treatment—Ether dissolves cholesterol, many gall stones are composed of this substance At the operation a rubber drainage tube without lateral fenestrations is insinuated through an opening in the common bile duct down to the calculus About six days later lipiodol is injected down the tube and a radiograph taken The first treatment with ether is undertaken a few hours later The amount of ether used varies with the diameter of the common duct When the duct is small only a few drops are used First the bile is sucked out with a syringe The syringe is then filled with ether, which is injected drop by drop Directly the patient feels pressure, suction is applied The injection is repeated several times in this way Finally, 1 c c of liquid paraffin is injected and the tube is clamped with a hæmostat The clamp remains until the patient feels pressure The procedure is repeated several times a day After a week's treatment a second cholangiograph is obtained The treatment is continued until it is proved that bile is passing freely from the common duct into the duodenum

THE PANCREAS

Post-operative Treatment—Escaping pancreatic juices tend to digest the abdominal wall and the sutures contained therein It is advisable to forestall the possibility of a burst abdomen by applying an abdominal corset forty eight hours after the operation *Digestion of the skin around the wound can be prevented* to a large extent by smearing it with paraffin ointment containing 0 2 per cent of hydrochloric acid, which renders the ferments impotent

In the early stages feeds should be pancreatized, and fats should be withheld as far as possible

CHAPTER XXX

THE MANAGEMENT OF LOWER ABDOMINAL CASES

By Hamilton Bailey

FOWLER'S POSITION

In order that purulent exudate shall collect in the pelvis rather than in the upper or middle abdomen, the aid of gravity is invoked It is not sufficient to order that a patient be placed in Fowler's position, it is necessary to see that the position is maintained effectively The house surgeon should imagine purulent fluid within the peritoneal cavity and then go to the bedside to satisfy himself that the angle at which the abdomen is set is sufficiently acute for fluid to trickle downwards If this is not done, George Ryerson Fowler's priceless gift to abdominal surgery—so simple, and yet so important—may be set at nought (*Fig* 221)

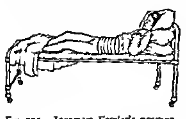


Fig 221—Incorrect Fowler's position.

In well-equipped hospitals there are special beds for maintaining Fowler's position Among a number of excellent specially constructed bedsteads of British manufacture may be mentioned the Lawson Tait (*Fig* 222) and the Melbourne Thomas bedsteads, such a bed makes the maintenance of Fowler's position a simple matter In less lavishly equipped institutions special supports known as the Sister Doris (*Fig* 223) and

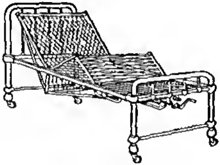


Fig 222—The Lawson Tait bed for maintaining Fowler's position.

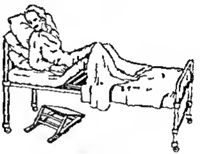


Fig 223—The Sister Doris bed support.

the Burton 'donkey' (*Fig* 224) are in use Both these latter operate beneath the mattress Fowler's position can be improvised on an ordinary bed by a bolster beneath the thighs A better substitute for the bolster beneath the thighs is one of the 'knee rests' such as the Dunlopillo (*Fig* 225) or the Stay Put (John Bell & Croydon) (*Fig* 226) These appliances are advantageous when Fowler's position has to be maintained in a private house All of them can be efficient, but the more rudimentary the apparatus the more strict must be the supervision

High Fowler's Position—This is employed in cases of peritonitis The head of the bed is raised eighteen inches on wooden blocks (*Fig* 227) Better than blocks is a fitting supplied by Hoskins and Sewell, of Birmingham (*Fig* 228), this bed lifter can be attached to any bedstead, and permits the bed to be wheeled about without any alteration of the patient's position

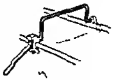


Fig 224—The Burton donkey

Special Note—Pressure on the under surface of the thighs occasioned by the bolster, and, to a somewhat lesser extent, by the other pieces of apparatus, favours venostasis and thrombosis in the veins of the calf Here is the starting place of many pulmonary emboli By ordering the legs to be exercised from the very first day of a patient being nursed in Fowler's position, and also prescribing pulmonary gymnastics, and by seeing that these measures are carried out faithfully, I think it no exaggeration to say that during his term of office the house surgeon will prevent at least one patient from getting a pulmonary embolus

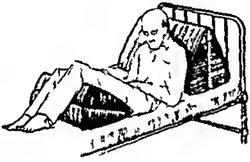


Fig 225—Maintaining Fowler's position with two Dunlopillo pillows

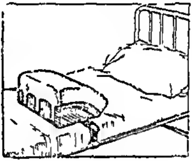


Fig 226—The Stay Put knee support

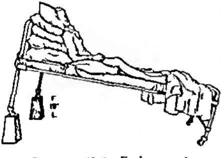


Fig 227—High Fowler's position maintained by wooden blocks, a bolster and pillows

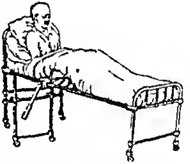


Fig 228—High Fowler's position, using the Hoskins bed-elevator and the Burton donkey

DRAINAGE TUBES

A drainage tube in the lower abdomen, while often a life-saving measure, becomes, if unattended, a menace After forty-eight hours the tube must be turned and it should be shortened It is only by attention to these points that a fæcal fistula and intestinal obstruction can be avoided Picture a tube in the lower abdomen with the patient in Fowler's position, coils of intestine must be

in juxtaposition to the tube If the tube is left undisturbed, pressure necrosis of an adjacent coil of intestine is almost bound to occur, that such neglect favours intestinal obstruction is equally evident The tube must be turned at the end of forty-eight hours The retaining stitch should be cut and a safety-pin inserted through the tube Usually on the third day the tube should be shortened considerably Personally, I generally remove the tube on the third day and substitute a piece of corrugated rubber, but there is no fundamental objection to leaving a *short* tube through the abdominal wall

To use gauze for the purpose of drainage is, I consider, unsound The heat of the body dries the absorbed pus and instead of the gauze functioning as a drain, it acts as a bung Vaseline gauze is not open to this objection

PRONE POSTURAL DRAINAGE

The prone position of draining the peritoneal cavity should be used more often Obviously it is mechanically sound As is seen in *Fig* 229, the left arm is flexed and the right arm is by the side The left leg is flexed slightly, and the right leg is straight The patient lies in this position for from half to three hours, and in many cases of pelvic peritonitis pus literally pours out through the suprapubic drainage tube I have been astonished at the effectiveness of this procedure when carried out by a skilful sister Another great advantage of the prone position is that it admits of considerable variation in posture without impairing dependent drainage These changes do much to relieve the weariness of any fixed position, and obviate the ever-present menace—venostasis and thrombosis

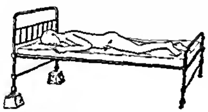


Fig 229—Prone postural drainage

THE MANAGEMENT OF CASES OF APPENDICITIS BY THE OCHSNER-SHERREN REGIME

The house surgeon will soon find out whether or not the surgeons to whom he is attached advocate this method If they do, he will have some interesting and responsible work. I might add that many of my house surgeons have been brought up in schools opposed to the method, but not one, after his term of office, has left unconvinced of the efficacy of the Ochsner Sherren regime

In any case, it is extremely useful to understand the correct details of the method, for the same principles are invoked by many in the treatment of certain cases of acute cholecystitis, pancreatitis, salpingitis, and pneumococcal peritonitis, as well as 'late' cases of appendicitis.

The surgeon will select the case which is to be treated by the delayed method. It will be a case of appendicitis of over 48 hours' duration, and particularly one where a localized mass is palpable

Taking the History—A careful history is essential Particular note is made of the number of hours since the onset The history begins "10, 26, 55 hours ago", not 'last Thursday", or "three days ago" A careful inquiry is made as to whether the patient has ingested a purgative The exact amount and nature of the purgative, and the time it was taken, and whether it was vomited, are recorded The recent ingestion of a powerful purgative may be a justifiable indication for performing operation which would otherwise be delayed

Recording Physical Signs—The physical signs are recorded in diagrammatic form (*Fig* 230) The extent of the rigidity is marked by shading The presence

of a lump is drawn as near as possible to scale on the diagram, and also outlined in indelible pencil upon the patient's abdomen The presence or absence of hyperæsthesia is always recorded, and the findings of the rectal examination are not omitted

Leucocyte Count—When facilities exist it is a good practice to order a leucocyte count and to have it repeated daily or every other day

Position—The patient is placed in high Fowler's position (p 193)

Charts—As a routine the pulse is recorded every two hours in graphic form on a special chart In cases where anxiety is felt as to the advisability of continuing the treatment, an hourly or even half-hourly chart is employed The temperature is relatively unimportant and is recorded every four hours

Vomiting is recorded on a separate piece of paper known as a *vomit chart* On this is entered the time at which the vomitus was ejected, together with the quantity and character of the fluid

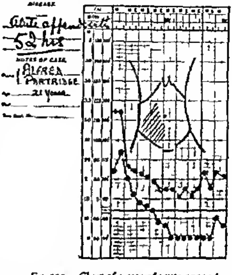


Fig 230—Chart of a case of acute appendicitis first seen 52 hours after the onset of the attack treated by the Ochsner Sherren method.

Drugs—It should be noted particularly that no morphine or its derivatives are given, and under no circumstances is a purgative administered Sulphonamide can be prescribed with advantage by the rectal or intravenous routes (*see* p 361) When the rectal route is chosen the dosage is as follows —

Sulphonamide tablets	4
Rectal saline	ad 4 oz
(Every four hours)	
Average dose in adults	16 g (32 tablets) in forty eight hours

Continuous Intravenous Saline—As everything by mouth is withheld for the first 24 to 48 hours, continuous intravenous saline and glucose must be commenced at once As a rule, there is no need to continue this form of therapy for more than 48 hours

Diet—After 48 hours the continuous intravenous saline is usually discontinued For 12 hours after this the patient may have cold plain water to drink, but he is not encouraged to drink more than is necessary to satisfy his thirst If by this time everything is not quite satisfactory, the plain water only by mouth is continued until the end of the fourth day If, however, the pulse, temperature, and local signs are satisfactory, flavoured glucose drinks and an occasional cup of commercial beef extract (which make the patient think he is having something very nourishing when actually he is being given little more than flavoured water) are substituted

On the fifth day feeding is usually commenced Small quantities of Benger's food, alternating with cups of beef extract, are given On the sixth day custard, jelly, strained gruels, and strained soups are allowed Thereafter the diet is increased intelligently

Bowels—The bowels are left confined if they are not opened naturally On the fourth or fifth day a small glycerol enema is given No purgatives of any

kind are given until resolution is complete—that is, until the temperature and pulse have been normal for a week and pain and physical signs are absent—then liquid paraffin, 2 drachms thrice daily, is prescribed

Co-operation with the Nursing Staff—The house surgeon should emphasize to the nurse in charge that he is to be called at any time she is not perfectly satisfied with her patient's progress Particularly she should report to him (1) A rise in the pulse rate, (2) Vomiting, (3) Pain, (4) In the later stages of treatment, diarrhœa or the passage of mucus in the stools (pelvic abscess)

If the nurse is not conversant with the Ochsner-Sherren regime, it is as well to put a notice over the patient's bed, "Nothing by mouth, frequent mouth-washes only No purgatives"

Explanation to the Patient and His Friends—It is most necessary to explain in simple language to the patient and his friends what is being done and why he is to be starved "To try to prevent the appendix bursting", is what I tell them It is equally important to make everyone understand that an operation may become necessary during the course of the treatment In favourable cases, during the first few days of treatment, the necessity of eventual appendicectomy must be broached in no uncertain tones and permission for it obtained If this important detail is omitted, once the symptoms have abated the patient may take the risk of getting a further attack I always try to emphasize how lucky is the patient who has been tided over, and give the impression that such luck cannot be expected twice—that another attack is probable within three or four months—and I rarely fail to get written permission for appendicectomy on a given date—usually two months after leaving hospital

Special Points which Foretell Possible Failure of the Treatment.—

A Rise in the Pulse-rate—An increased pulse rate is the most reliable single sign that it is dangerous to proceed with the delayed method If the pulse-rate has increased even 10 points in the first four hours, operation is often indicated

Temperature—A moderate rise in temperature is quite often indicative that the patient is exhibiting a good reaction to the inflammatory process, it does not necessarily mean that a local abscess is developing, though this, of course, may be the case, and will be revealed by the physical examination A moderate rise of temperature with a pulse rate of 80–90 does not foretell failure of the delayed treatment

Vomiting—After the first few hours, vomiting should always be regarded seriously, and thus by itself may be a sufficient indication to abandon delayed treatment

Pain—A patient undergoing delayed treatment should not complain of pain, as opposed to tenderness, after the first six hours of treatment If he does there is usually something wrong, and this is a strong indication for operation

Development of a Pelvic Abscess—The passage of mucus and relaxed stools is very suspicious that a pelvic abscess is developing In all cases undergoing the Ochsner Sherren treatment a rectal examination should be made periodically If a mass can be felt, a daily rectal examination is necessary

It should be needless to add that the Ochsner-Sherren treatment of appendicitis is only to be undertaken in a properly equipped institution where operation can be carried out (if necessary) at once

In order that there should be no misunderstanding, the house surgeon is advised to get into immediate touch with his chief if (1) The pulse is rising, (2) The patient vomits, (3) The patient complains of pain, (4) The mark on the abdominal wall shows that the localized swelling is increasing in size, (5) Signs of a pelvic abscess are in evidence

CHAPTER XXXI

THE MANAGEMENT OF SOME COMPLICATIONS AFTER ABDOMINAL OPERATIONS

By HAMILTON BAILEY

SEVERAL important complications are described elsewhere in the book, e g POST-OPERATIVE RETENTION OF URINE (p 235), POST-OPERATIVE PULMONARY COMPLICATIONS (Chapter XXIV)

FLATULENCE

Flatulence causes much post-operative discomfort It occurs in some measure after most abdominal operations The following simple carminative may be prescribed —

℞	Aspirin	gr xv
	Sod Bicarb	ʒss
	Sal Volat	ʒss
	Aq Menth Pip	ad ℥ss

Oil of cajuput, ♏iij, on a lump of sugar is of definite value in helping the patient to pass flatus A rectal tube can be passed and left in situ for an hour The best type of rectal tube has a terminal eye, and not one at the side like a catheter If there is no contra-indication, a turpentine enema gives much relief In more severe cases acetylcholine 0 1 g every two or three hours for three doses, or a dose of pitressin, preferably given intramuscularly into the deltoid, may be prescribed It is inadvisable to order these drugs unless the wishes of the surgeon in charge of the case have been consulted

Where severe post-operative flatulence ends and paralytic ileus begins, no one knows The treatment of the latter is difficult, and various views are held as to the best course to adopt If the patient is not responding to simple remedies, the girth of the abdomen at the umbilicus should be measured and recorded, and instructions given for a two- or four-hourly pulse-rate reading to be taken and the surgeon to be informed

ACUTE DILATATION OF THE STOMACH

Acute dilatation of the stomach is not excessively rare By the aid of the gastric aspiration tube acute dilatation can be diagnosed and treated efficiently even *before the patient vomits* One vomit of the characteristic fluid should always be sufficient indication for the passage of the tube If we keep the condition in mind and pass an aspiration tube when the patient feels nausea and has a rising pulse-rate, milder degrees of acute dilatation, which may or may not be associated with paralytic ileus, can be treated successfully

No possible harm can accrue from what may be called ' sounding the stomach ' in suspicious cases I used to be afraid of distressing the patient, especially when the diagnosis was in reasonable doubt, but so often has the benefit from the passage of a gastric aspiration tube outweighed the misdirected compassion

of withholding it that I feel most strongly that to procrastinate even for a few hours is the antithesis of good judgement. Over and over again a quantity of dark fluid is aspirated, and the diagnosis of at least some degree of acute dilatation is established. Even if the stomach is found to be empty, extremely important diagnostic data have been obtained.

Treatment of Established Cases.—The principles are: (1) Empty the stomach and keep it empty; (2) Administer continuous intravenous saline; (3) Invoke the aid of gravity. Posture, which until recently was given prior place in treatment is, I consider, relatively unimportant. This is fortunate, for to be compelled to turn a patient with a laparotomy or suprapubic wound on to his face, and to raise the foot of the bed, is not desirable if it can be avoided. If the patient is responding to the first two measures—and usually the response is undeniable—the application of the third is unnecessary.

In late cases the aid of gravity cannot be neglected. The German method of placing the patient in high Trendelenburg's position is more generally applicable than the prone position with elevation of the foot of the bed.

PARALYTIC ILEUS

The condition is very worrying, and there are two schools of surgical opinion regarding its treatment.

The school of stimulation prescribe drugs to stimulate peristalsis.

The school of rest believe that to try to stimulate the gut in this condition is like whipping a tired horse (*Fig.* 231).

Apart from all other considerations, gastric aspiration should certainly be instituted by the house surgeon as early as possible, for not infrequently the condition is associated with at least some degree of acute dilatation of the stomach.

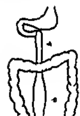


Fig. 231.—Diagram showing why purgatives often fail in the treatment of paralytic ileus. A, Comparatively healthy small intestine readily excitable by purgatives; B, Paralysed intestine, unexcitable by purgatives.

I am strongly of the opinion that once distension has occurred any drugs designed to stimulate peristalsis further jeopardize more lives than they save. Even the newer preparations such as acetylcholine, doryl, and esmodil come under this category. Followers of the school of rest prescribe morphia, to be followed, after the patient has had a good rest, by a turpentine or ox-bile enema. Anti gas gangrene serum is also prescribed. If these measures are not effective and the patient is experiencing nausea or vomiting, gastric aspiration is essential. Continuous intravenous saline and glucose is administered. Cajuput oil, 1 min., may be ordered to help the patient to pass flatus, and this can be repeated after six or eight hours. Another turpentine enema is given; even if this should produce no result, providing the diagnosis is assured and the patient's condition is not deteriorating, a further twenty-four hours' rest is ordered. Intestinal aspiration (*see* p. 100), as yet in its infancy, may well prove the solution to the treatment of this most difficult problem.

A spinal anæsthetic is sometimes effective when other measures have failed. In a desperate case I have had success by giving a spinal anæsthetic and then passing a sigmoidoscope. A rectal tube was insinuated high in the colon through

the sigmoidoscope Whether the good result was due to the spinal anæsthetic or the intubation I do not know

Potter's Preventive Treatment of Paralytic Ileus—*It should* be noted carefully that this is preventive treatment, i e, the treatment is started *before* distension occurs

Potter describes his treatment as follows —

1 Pitressin, ½ c c, is given intramuscularly, preferably into the deltoid If given subcutaneously it is often absorbed too slowly to produce the desired effect

2 The initial dose must be given in the presence of non distended intestine Hence the first dose is given at the beginning or immediately after the operation, and it is given twice a day for eight to twelve days

My experience is that both pitressin and acetylcholine are valuable, providing they are commenced before the distension occurs Both can be dangerous if given later In a few cases acetylcholine can have the exactly opposite effect to the therapeutic action for which it is intended

FÆCAL FISTULA

The first thing to do is to be quite certain that there is really a fæcal leak Many times a fæcal fistula is reported when in reality a foul, fæcal smelling pus has been discharged from the wound The passage of flatus with the discharge is proof positive of a communication with the bowel

The house surgeon will institute the following measures —

1 Place the patient in Fowler's position

2 Provide free exit for the fæcal matter through the abdominal wall by the insertion of a soft corrugated rubber drain

3 Provide efficient corsettage to the wound (*see* p 26) After the corsets have been applied he should make certain that they are sufficiently tight to prevent the wound bursting open, but still allow free drainage of the wound

4 Make arrangements for the prevention of skin excoriation

The Prevention and Treatment of Skin Excoriation—*This is a difficult* problem The number of local applications which have been recommended for the purpose are so numerous that this, in itself, is good evidence that none is universally satisfactory I have tried them nearly all, and have found much the best is kaolin paste, providing it is applied as soon as possible after development of the fistula A sufficient quantity of sterilized powdered kaolin is mixed with glycerin to make a thin paste It is applied to the skin surface, and over it is spread a generous quantity of powdered kaolin The application is renewed every six hours

Suction—The higher the fistula in the alimentary canal the more skin excoriation must be expected This reaches its zenith in cases of duodenal fistula Undoubtedly, some form of suction apparatus to remove the enzyme-laden discharge is a fundamental procedure In cases of duodenal fistula suction is imperative

Potter has found that a glass tipped rubber tube connected to the suction apparatus operated by the patient himself is a satisfactory method of applying the suction in appropriate cases

Drugs and Diet—Pulv cret aromat, given in teaspoonful doses every four hours, helps to thicken the discharge and so prevents an unbridled outpouring, it also has the effect of lessening the offensiveness of the fæcal discharge After a few days the patient seems to develop a tolerance to pulv cret aromat and the dose has to be increased I have found that a better practice is to

substitute isogel for the chalk powder for four or five days, and then to return to the powder

Diet should consist of milk preparations at frequent intervals, and three times a day the white of an egg should be given

Watch must be kept that the patient is receiving an adequate fluid intake Timely administration of intravenous saline and glucose will prevent dehydration In the case of high fistulæ a jejunostomy for feeding purposes may have to be considered, for the higher the location of the fistula the greater the menace to life

Prone Postural Treatment —In selected cases, and especially during the night, the patient can be placed in an anterior Bradford frame with a slit in the region of the fistula (*Fig* 232) A bed pan beneath the opening serves as a receptacle for the discharge Within a very short time the patient accustoms himself to sleeping on the frame.

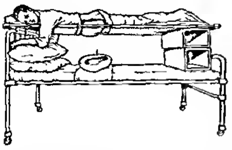


Fig 232 —Nursing a patient in the prone position on a Bradford frame The fistula leaks directly into the receptacle (*After Po er*)

BURST ABDOMEN

Prevention.—Certain conditions are known to predispose to burst abdomen Amongst the more important are the following (1) Violent or persistent cough, (2) Infection of the laparotomy wound, (3) Intestinal obstruction with distension, (4) Escaping ferments, notably in acute pancreatitis, (5) Hasty closure of the wound, (6) Ascites, (7) Extreme debility of the patient—tissues fail to heal

There are many occasions where the accident can be prevented by supporting the abdominal wall with laparotomy corsets (*see* p 26)

Immediate Treatment.—From the clinical standpoint, burst abdomens are of two varieties The house surgeon may be summoned hastily because the wound has given way and coils of intestine are prolapsed on to the abdominal wall This is the common variety Less frequently the wound breaks open more quietly, revealing a mass of reddish tissue beneath One hopes that this mass is the rectus muscle, but it nearly always turns out to be a coil of small intestine covered with granulation tissue In other words, the abdominal wall has given way a few days before, and the prolapsed coil has been covered only by skin Thus it comes about that if there is uncertainty as to the nature of the reddish tissue it is safer to ascertain this point in the operating theatre

The immediate treatment is to cover the wound and the prolapsed contents with hot moist gauze The patient is told not to cough if this can possibly be avoided Pain and shock are singularly absent, but in order to quiet the patient and to aid relaxation under the anæsthetic, morphia, $\frac{1}{4}$ gr, is administered at once, and arrangements for operation are made forthwith.

STITCH ABSCESS

In these days of absolutely sterile catgut it is improbable that stitch abscesses are often due to suture material. If numbers of cases occur in a short space of time, there is probably something amiss in the sterile ritual of the theatre On one occasion, after a prolonged search, an epidemic of stitch abscesses was traced to infected powder used with the rubber gloves

Stitch abscess is treated in the same way as any other abscess, but it should be noted that a little redness around the wound is not always the signal that a fomentation should be applied, and the surgeon's wish should be consulted in such cases If the whole wound is inflamed, precautions against a burst abdomen should be taken forthwith

PERSISTENT HICCUP

Persistent hiccup is a distressing complication, sometimes seen after abdominal operations, although it is by no means rare in uræmic subjects It is a serious complication, distressing for the wretched patient, upsetting to the other patients, and distracting to the staff Morphia sometimes controls it for a time, but persistent hiccup is almost untouched by this drug

The numerous remedies which have been recommended are divergent in principle We will assume that carminatives and holding the breath have been tried without avail *The first thing to do is to make certain there is no dilatation* of the stomach, by passing a gastric aspiration tube In relevant cases it is a good practice to take a sample of blood for a blood urea estimation A reliable method of treatment is to get the patient to inhale air containing an excess of CO_2 A homely method is to get him to breathe in and out of a thin paper bag for half a minute or so at a stretch The inhalation of 5 per cent CO_2 is often effective It is quite useless to blow the CO_2 in front of the patient's nose, it must be given properly with an anæsthetic mask Inhalation should be given from 3 to 15 minutes and charted thus —

Time	*CO_2 Inhaled for*	*Freedom from Hiccup*
3 30 a m	10 minutes	20 minutes
4 a m	5 minutes	30 minutes

I have used the method in a number of cases with favourable results A State registered nurse is quite capable of using the method once it has been

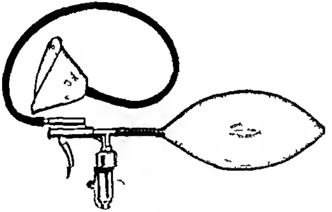


Fig 233 —Sparklet "resuscitator with mask

demonstrated to her The sparklet "resuscitator" with a mask attached (*Fig* 233) was designed by me so that objections to a nurse giving CO_2 were overcome

Some speak well of an inhalation of amyl nitrite, and among the newer remedies benzedrine sulphate in doses from 10 to 30 mg must be mentioned Several reports have been published where a dose of 10 mg (two tablets of

benzedrine) has controlled the hiccuping for twenty minutes, when the dose can be repeated, if necessary, for two or three doses I have tried this remedy but have had no success with it

Finally, exposure of the left phrenic nerve and injecting it with local anæsthesia is a comparatively trivial procedure On several occasions I am sure that this measure has proved life saving

ACIDOSIS

(*Ketosis*)

Acidosis is a well known complication after general anæsthesia in children For Rothera's test, *see* p 45

Prevention —After emergency operations on little children it is a good practice to order saline and glucose per rectum

Acidosis should be suspected when vomiting for which there is no apparent reason continues for more than forty-eight hours after operation and the patient is a little child A characteristic odour of new mown hay in the child s breath helps to confirm a suspicion of acidosis

Treatment.—

Glucose —It is of the utmost importance to get glucose promptly into the circulation Six to eight ounces of a 10 per cent solution of glucose in saline are given slowly per rectum This is repeated every four hours The nurse should be told to report if the solution is not retained If this is the case, a 5 per cent solution may be given subcutaneously In urgent cases a 5 per cent solution may be given intravenously The stomach should be washed out if vomiting continues, using a small stomach tube

Other Forms of Treatment —Sodium bicarbonate in large doses is useful and insulin is stated to be of value Regarding the administration of the latter, it is advisable to seek the help of a medical colleague

CHAPTER XXXII

THE RECTUM

By W B GABRIEL

PROCTOSCOPY

THE rectum should preferably be empty, but a little formed fæcal material is no great handicap, for it can be removed by swabbing The tubular proctoscope (*Fig* 234) has proved efficient both for diagnosis and proctoscopic treatment Brilliant illumination is essential The anglepoise standard light has proved most satisfactory for a rectal examination Proctoscopes are now on the market with a built-in electric light attachment The proctoscope is sterilized by boiling, and is laid on a sterile towel to cool Fitted with its obturator, and lubricated, the proctoscope is passed by gentle pressure into the anal canal

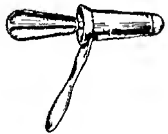


Fig 234—Tubular proctoscope

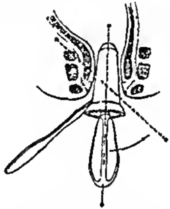


Fig 235—Proctoscopy diagram to show change of direction required after passing instrument through the anal canal.

If the patient is lying in the left lateral position, with his knees drawn up, the direction of the anal canal is upwards and forwards The proctoscope should accordingly be passed at first towards the patient's umbilicus, when the instrument is felt to pass through the anorectal ring into the rectum its direction is altered (*Fig* 235), the tubular part now being directed more posteriorly

The proctoscope is inserted up to the full distance allowed by the flange, the obturator is withdrawn and the light directed in If the patient relaxes properly, the lumen of the rectum will be seen to open as air enters

The *normal mucous membrane is pale* Capillaries and sometimes tributaries of the superior hæmorrhoidal vein are visible Any change, e g, inflammation, ulceration, or neoplastic formation, will be observed

As the proctoscope is withdrawn, the mucous membrane begins to close in, prolapsing internal hæmorrhoids will *become apparent* as they bulge into the lumen of the instrument As it is withdrawn farther, lesions in the anal canal, e g, a fissure, will become apparent

If the problem is that of bleeding at defæcation, it is often advisable to introduce the proctoscope a second time, and ask the patient to strain down as it is withdrawn in this way the internal piles become congested and a bleeding point may be revealed. The frequency with which bleeding comes from a superficial fissure in the anal canal deserves mention

Records—The results of a rectal examination are conveniently recorded by the use of two circles (*Fig* 236) The outer circle represents the anal margin, the inner circle represents the upper end of the anal canal Local lesions such as piles, fissures, fistulæ, etc, can be shown in a graphic manner The same system is used for recording operative procedures in this region

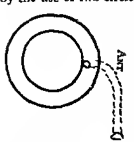


Fig 236—Facsimile of a record of the findings in a case of fistula in ano

SIGMOIDOSCOPY

The passage of a sigmoidoscope is commonly required as part of a rectal examination, and is readily performed immediately following digital and proctoscopic examination without anæsthesia or further preparation A proximally-lit sigmoidoscope such as Yeomans' (*Fig* 237) (with 8-in or 10-in tubes) or Morgan and Officer's pattern (25 cm) has many advantages

Sigmoidoscopy is carried out with the patient in Sims' position. The instrument, warmed and lubricated, is passed through the anal canal into the ampulla of the rectum The obturator is removed and the eyepiece, light, and bellows are attached The rest of the examination is done under direct vision and no attempt should be made to pass the instrument blindly into the upper part of the rectum

After carefully examining the rectal ampulla the sigmoidoscope is passed in farther, and at this stage, while following the sacral curve, the outer (eyepiece) end of the instrument must be held rather far forwards, if this is not done sufficiently the inner end of

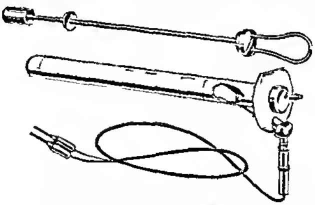


Fig 237—Yeomans' sigmoidoscope

the tube will impinge on the anterior rectal wall and in consequence the lumen of the rectum will not be apparent When the upper rectum has been reached at about 6 inches from the anus the direction of the bowel forwards and to the left must be followed, the uppermost, left, valve of Houston must be passed and the instrument will then proceed through the recto-sigmoid region into the lower pelvic colon Spasm or an organic stricture may, however, prevent this During the examination air should be gently blown in with the bellows to keep the bowel lumen opened out, forcible air distension should be avoided as it may cause pain and spasm

The presence of blood and mucus should be noted and any organic lesion such as inflammation or ulceration of the mucosa, polypi, or a carcinoma must be recognized The total distance visualized should be recorded, also the distance from the anus of a polyp, etc, and the quadrant affected If a carcinoma is seen a portion of the edge of the ulcer should be removed with *Brunings* or a punch forceps for biopsy, and is a safe and routine procedure

PREPARATION FOR OPERATION

In some cases no preparation is required for instance, before opening an acute anorectal abscess the administration of an enema causes unnecessary suffering The skin preparation in such a case is postponed until the anæsthetic has been given

Routine Operation —In the case of a routine rectal operation the following schedule is suitable —

Evening but one before Operation —An aperient, graded according to the patient's habits, is ordered

Day before Operation —

Morning A small dose of salts

Evening A soap and water enema, perineum to be shaved, bath

Diet Light lunch and dinner

Day of Operation —Two hours before the operation the rectum is washed out with half a pint of plain water

Radical Operation —A longer period, i e, five to ten days, should be allowed for the preparation of a patient for a radical excision of the rectum The diet should be of a light, low residue character, and the free intake of fluids should be encouraged

The general preliminary examination will include a survey of the heart, lungs blood pressure, and urine analysis Pathological investigation will include estimation of the blood urea, blood group, often also the red cell count and hæmoglobin Suitable relatives should be grouped with a view to having an available donor tested and cross matched prior to the operation

Aperients —An aperient such as ½ oz of liquid paraffin and ½ oz of milk of magnesia is given orally each evening, and a soap and water enema is administered on alternate nights, the last enema being timed for the evening before operation A rectal tube is passed a few hours before the operation with the object of ensuring that the patient comes to the operation with a rectum which is free from fluid

Skin Preparation —In all cases in which an excision of the rectum may be a possibility, it is the house surgeon's duty to see that both the abdomen and perineum are prepared for operation, and in male cases he should tie in a gum-elastic coudé catheter immediately before the patient is brought to the operating theatre

POST-OPERATIVE TREATMENT

Immediate —The patient is returned to bed and is placed on his back, at any rate for three or four hours or longer, in order to assist the firm support of the anal dressings Retention of urine is often a difficulty after rectal operations, but the number of cases which require catheterization has been greatly reduced by the hypodermic injection of 1 c c. of doryl or esmodil to stimulate contraction of the bladder musculature

First Day —Remove the tube from the rectum by gentle traction twenty four hours after operation Cut off the excess of gauze but leave in situ the corners of gauze that have been tucked into the anal canal Change the outer dressing and dress with

gauze soaked in eusol lotion Apply dressing firmly with a pad of wool and T bandage This should be done morning and evening Fluid or very light low residue diet

Second Day—Dress as above morning and evening 7 30 p m Liquid paraffin ½ oz Cascara evacuant ½ drachm (or equivalent aperient) 9 0 p m Milk of magnesia ½ oz in an equal part of water

Third Day—An olive oil and gruel enema (*see* p 104) is given into the rectum before the bowels move this is given before or after breakfast according to whether the patient feels the bowel action imminent The patient should retain the enema for five to ten minutes, and then pass it *without straining* A bed pan should be used for this first action if there is no hæmorrhage in the stool a commode or a neighbouring W C. can be used for subsequent actions Light or ordinary diet.

It should be noted that in certain cases—for instance, after amputation of a rectal prolapse—it may be desirable to postpone the first bowel action till the fifth to the seventh day after operation *In such cases clear instructions must be given to the nursing staff*

Daily Dressings—The routine for subsequent dressings is as follows The patient is placed on his or her left side with the buttocks lifted out over the edge of the bed, a mackintosh sheet is placed underneath and is led over the side of the bed into a bucket The anus is gently irrigated from a douche-can which is fitted with a yard of rubber tubing and a single nozzle (*Fig* 238), carefully sterilized before use, with 2 pints of dilute peroxide solution, or dettol ½ oz to a pint A firm gauze dressing is then applied, the gauze being soaked in eusol, a corner of the gauze should be tucked into the anal canal with sinus forceps and the excess arranged firmly outside The patient is allowed to take a bath on the evening of the third day, and thereafter morning and evening before the dressings The bowel actions are regulated with liquid paraffin and cascara or magnesia, according to individual needs, care should be taken not to over-purge the patient When a clean healing surface is present the dressing may be changed to lotio rubra, cod liver oil and vaseline, or a scarlet red ointment In the final stages of healing the anus should be kept dry by the application of a zinc, starch, and boric dusting powder

Fig 238—Rectal dressing An anal wound is being irrigated. The sheet upon which the patient lies is led into one bucket, the other being used for dirty dressings

Management of the Sphincter.—In practically all operations on the anal canal and lower rectum, open wounds must be left to heal by granulation. It is the house surgeon's duty to supervise the healing of these wounds and ensure that premature healing and bridging do not occur A successful result, particularly after operations for cure of fissures and fistulæ, largely depends on careful dressings, and on the management of the sphincter

Painful dressings may be eased by smearing the gauze which is to be tucked into the anal canal with a zinc and castor-oil cream, to which 3 per cent anæsthesin or decicain (Bayer) may be added In most cases it is found advisable, in addition,

to perform a routine dilatation of the anal canal after operation, this may be done digitally, or by passage of St Mark's Hospital dilator (*Fig* 239), the larger pattern of this dilator has a maximum diameter of 1 inch

In the management of fistula cases after operation the passage of this dilator once a day from the fifth or sixth day after operation is advocated The passage of a dilator does not exclude the necessity for periodically examining the granulating wound with a finger and probe, by which means any roughness or pocketing, or the presence of unopened tracks, may be detected and suitably dealt with

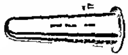


Fig 239—St Mark's Hospital dilator

Undue exuberance of granulations should be an indication for paring them down with scissors and cauterizing them with a stick of silver nitrate

In cases of fissure the dilator may with advantage be passed twice daily from the evening of the fourth post-operative day In these cases, even after the fissure has healed, it is advantageous for the patient to have a dilator for passage at increasing intervals, to make certain that the calibre of the anus is maintained at its proper size

MANAGEMENT OF REACTIONARY OR SECONDARY HÆMORRHAGE FROM THE RECTUM

Untoward hæmorrhage occasionally occurs after a rectal operation

Reactionary hæmorrhage from an exposed vessel calls for no special comment The house surgeon must secure and ligate the vessel promptly

Reactionary or secondary hæmorrhage *from inside the rectum* is a more serious complication, and the method of dealing with this by plugging the rectum should be clearly understood

Method of Plugging the Rectum—After giving an injection of morphia the patient is placed on his left side with buttocks well over the edge of the bed A large proctoscope is passed, and a large amount of blood and clot will be evacuated The rectum is irrigated with hot (105° F) lotion With the proctoscope still in position, a stout-walled rubber tube of ½-in outside diameter, with a gauze 'surround' wrapped round it and smeared with vaseline, is pushed into the rectum through the proctoscope (*Fig* 240) As soon as the tube and 'surround' are felt to slip into the rectum, the proctoscope is withdrawn over the outer free end of the tube Traction on the tube now brings the gauze up against the anal canal, and in this position efficient pressure is exerted against a bleeding point in the internal hæmorrhoidal region A stout safety-pin is passed through the tube just external to the anus, and a gauze strip, several feet in length, is wound round the tube, between the anus and the safety-pin. A firm pad of gauze and wool is applied The foot of the bed is raised on blocks, and the usual general treatment of hæmorrhage is adopted

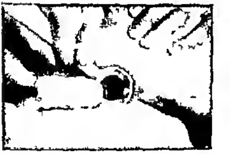


Fig 240.—*Post-operative hæmorrhage from the rectum.* Method of introducing a tube surrounded by gauze into the rectum through a proctoscope (*From the author's* Principles and Practice of Rectal Surgery, H K Lewis London)

The external dressing is inspected at regular intervals to see if further hæmorrhage is taking place. This very seldom happens, and the tube and 'surround' are removed by traction forty-eight hours later; a preliminary rectal injection of olive oil should be given, and a plain tube (without gauze) should be left in the rectum for another day to reveal any further bleeding.

MANAGEMENT OF A COLOSTOMY

Opening a Colostomy.—A colostomy is sometimes left unopened at the time of operation, and it is the house surgeon's duty to open it twenty-four to forty-eight hours later. The indication for doing this is the complaint of attacks of colicky abdominal pain and the development of abdominal distension. A cautery should be used rather than scissors, because less hæmorrhage will result. No anæsthetic is required; the patient can be assured that the opening will be made painlessly.

After-treatment.—The skin sutures should be removed from the colostomy wound not later than the sixth or seventh post-operative day; if left in longer than this, stitch sepsis is likely to develop. The glass rod is left in for at least

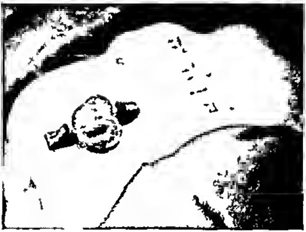


Fig. 241.—Left iliac colostomy. Rubber tube substituted for glass rod. (*From the "British Journal of Surgery."*)

two weeks, and at the end of that time may be removed, or if it appears advisable on account of incomplete healing to hold up the colon for a longer period, a rubber tube with overturned ends (*Fig.* 241) may be substituted for the glass rod; it is softer and can be worn comfortably even when the patient is sitting up out of bed.

Care of an Artificial Anus.—The first bowel action from a colostomy may take place spontaneously on the second or third day after operation. A gentle aperient such as liquid paraffin (½ oz.) and milk of magnesia (½ oz.) may be given on the third or fourth evening after operation, and if difficulty is experienced in promoting an action, an injection of 1 oz. each of glycerin and olive oil may be run into the proximal opening. Subsequently the aim should be for the patient to have a motion from the colostomy each morning after breakfast, and sometimes a smaller one about tea time.

Alternative Routine—In some cases the advisability of giving a daily wash-out into the colostomy may be considered It has the disadvantage that a state of catarrh may be induced in the colon by this routine, particularly if soapy water is used for the injection Normal saline is preferable, but even so the bowel is likely in time to become *irritable and contracted* *More serious drawbacks* are that occasionally, if a colostomy wash-out is given too forcibly, some of the fluid may be forced back into the ileum and produce abdominal pain, and rarely the colon has been perforated by a rectal tube being thrust through the bowel wall, or through a diverticulum, with the rapid onset of peritonitis

Late Management.—Some technical points are involved in the late management of a colostomy —

1 If the colostomy is a loop type made prior to a perineal excision of the rectum, it will be advisable to render the distal colon and rectum as clean as possible in preparation for the second-stage operation About a week after the colostomy operation 3 to 4 oz of olive oil should be run into the distal colostomy opening each night through a tube and funnel, and in the morning the patient is placed on a bed-pan and a wash-through is given in a similar way the solution may be warm water, saline, or saline and bicarbonate

2 If the colostomy is a palliative one, it may be helpful to give a saline wash through in a similar way two or three times a week, in order to keep the distal bowel as clean as possible and remove irritating blood and mucus from the rectum

3 The late complications of colostomy are skin stenosis, spur retraction, prolapse, and formation of a ventral hernia For some of these a secondary operation for reconstruction of the colostomy may be needed

Diet of a Patient with a Colostomy.—The intake of 'roughage' must be regulated according to the individual patient usually it is advisable to allow no green vegetables at first later fruit, then salads, are given, and as the patient's convalescence proceeds, a full diet can be worked up If the bowel is sluggish a small portion of stewed apples or prunes in the evening often proves more efficacious than laxatives such as senna or magnesia

MANAGEMENT AFTER EXCISION OF THE RECTUM

When the patient is returned to bed after an excision of the rectum, whether perineal or combined, he should be placed on his back, the sacrum and perineal dressing resting on a partially inflated air-ring The dorsal position assists the falling backwards of the pelvic organs, and for the first few days after operation the patient should not be allowed to lie on his side

The foot of the bed is raised on 9-in or 12-in blocks, and for the first twenty-four hours after operation the chief care is in regard to the cardiovascular system

The blood pressure should be taken on the patient's return to bed, and a half hourly record kept of the pulse-rate If a drip blood transfusion is given this will need watching, and when the blood has finished running, a continuous saline and glucose drip (at the rate of 40 to 50 drops per minute) may be continued Officer's pattern of transfusion apparatus is particularly suitable for these cases (see p 90)

The state of the lungs will need careful consideration, if there should be any sign of a moist bronchitis, the blocks must be removed, and the patient inclined up at a gentle slope It should be observed that a high Fowler position is most undesirable after excision of the rectum, as pressure sloughing of the sacral end of the wound is prone to develop Injections of atropine ($\frac{1}{100}$ gr four-hourly) often quickly relieve the pulmonary condition *Inhalation of CO_2 and oxygen is also indicated*

The abdomen should be examined to see that no distension is developing After a combined excision of the rectum, *intestinal movements* should be heard on auscultation, and even if no colostomy action has started, the knowledge that the small bowel is *contracting* ***normally*** *is encouraging* Liquid paraffin may be given orally on the third or fourth post-operative day, supplemented by milk of magnesia if thought advisable

Vomiting after twenty four hours should especially be noted, and the upper abdomen palpated for evidence of a dilated stomach (p 197) The mortality from small-intestinal ileus has been greatly decreased by the *early* passage of a gastric aspiration tube this should be done in the earliest stages of a rising pulse rate before vomiting commences (*see* p 198)

Management of the Urine—In male cases the indwelling catheter is connected to a St Mark's Hospital apparatus (p 238)

In women a catheter is passed every six to eight hours after operation, and a bladder wash-out given once or twice daily until normal micturition is resumed.

Management of the Wound—The patient is usually returned to bed with some form of perineal packing

One excellent method which has been in routine use for a number of years is to place a sterilized rubber bag (made by the Dunlop Rubber Co) in the perineal wound and pack it with one or two 6-yard rolls of gauze This packing, together with the bag, may be removed in forty eight hours after a perineal excision, and in sixty hours after a combined excision, the method is to place the patient on his left side on a mackintosh sheet and remove the packing and bag under a stream of dettol lotion (½ oz to 1 pint) Thereafter the wound is irrigated twice daily with dettol, eusol, or peroxide, and a light packing of gauze moistened in eusol is tucked into the aperture left for drainage The sutures should be removed on the sixth or seventh post-operative day, or earlier if redness or tension is observed

Later, as the wound closes in and becomes clean, a change may be made to red lotion or ichthyol in glycerin (5 per cent) Throughout this time the wound needs careful and regular inspection to guard against premature healing and pocketing in its depth. An evening pyrexia for no apparent reason is likely to be due to a deep abscess in the wound or urinary infection

In aged subjects a form of deep bed sore may develop at the posterior end of the perineal incision, with sloughing of the posterior sacral ligaments In this case the posterior part of the incision must be laid open under local anæsthesia to permit eusol gauze dressings to be applied directly to the sloughing area Slow but complete healing can be anticipated

EXTERNAL HÆMORRHOIDS

Thrombotic External Pile (syn *Anal Hæmatoma*)—This should be excised. The patient is placed on his left or right side so that the hæmatoma will lie on the *under* aspect of the anus Local anæsthetic is injected, the initial puncture must be at least half an inch external to the swelling Enough skin is excised to leave a racket shaped wound which will remain flat and heal by granulation (Fig 242)

AFTER-TREATMENT—The wound is dressed twice daily with gauze soaked in eusol lotion, a corner of the gauze being tucked into the anus in order to keep the skin margins flat The wound will as a rule be healed in ten to twelve days This operation is most suitable if the hæmatoma is a solitary one, situated on one or other side of the anus

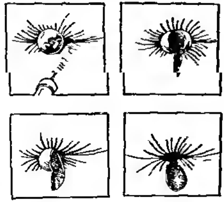


Fig 242—Excision of an anal hæmatoma. The drawings show the successive stages from the superficial injection of procaine to the splitting of the swelling into two portions and their excision. Adequate external drainage by a pear-shaped wound is effected (*From the author's Principles and Practice of Rectal Surgery*, *H K. Lewis London*)

A hæmatoma in the middle line anteriorly or posteriorly should be treated with lead lotion compresses unless it is very large, in which case a triangular wound (as for a fissure) will be necessary to minimize the risk of a fissure developing. The conglomerate type of hæmatoma, in which multiple clots and much related œdema are present, should also be treated palliatively, as excision of this would denude too large an area of anal margin.

Anal Skin Tags.—These constitute another type of external hæmorrhoids and may require local excision. Before doing this, however, the rectum should be carefully examined to make sure that a prolapsing internal hæmorrhoid is not present. Skin tags situated laterally can readily be snipped off with scissors after injecting a few drops of novocain at the base; if placed anteriorly or posteriorly much care must be taken to leave a triangular wound of adequate size, or a fissure is liable to result; if sphincter spasm is present the deep posterior injection of proctocaine or percaine in oil is indicated (*see* p. 215).

INTERNAL HÆMORRHOIDS

Palliative Treatment.—If a patient is seen in an acute attack of prolapse, with thrombosis, ulceration, or sloughing, an attempt should be made to return the piles inside the rectum; pressure is applied digitally, with gauze or cotton wool, and a short anæsthetic may be necessary. If, however, the sphincter is relaxed and stretched by the prolapsing piles, they will probably prolapse again immediately after reduction. In any case, whether reduction is successful or not, the patient should be kept in bed until all infection and œdema have subsided. Four hourly compresses of eusol, perchloride lotion 1-2000, or lead lotion should be applied. Liquid paraffin is given orally, and olive oil enemata are indicated if constipated fæces are present in the rectum.

Injection Treatment.—The injection treatment of internal hæmorrhoids is indicated in the early stages, particularly when bleeding rather than prolapse is the chief symptom. After a preliminary proctoscopy to define the piles and, if possible, identify the one which is responsible for the bleeding, the speculum is reinserted to its full length, and a submucous injection of 5 per cent phenol in almond oil is given. A suitable syringe and needle for this technique is shown in *Fig.* 243. Two important points in technique should be stressed: (1) the

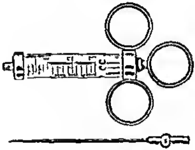


Fig. 243.—The author's syringe for use in the injection treatment of hæmorrhoids.

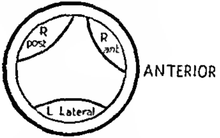


Fig. 244.—The three primary internal hæmorrhoidal areas. (The patient is in the left lateral position.)

injection must be given at the upper end of the pile, at or slightly above the anorectal ring; and (2) the bevel of the needle should be directed towards the mucosa on the side which is being injected, rather than towards the lumen of the rectum—in this way it is easier to insert the needle correctly into the submucous layer. The phenol in oil solution is injected slowly. The amount injected into any quadrant is usually 1 to 3 c.c.; the injection is stopped before the tissues become tense. Some blanching is usually seen, with the capillaries standing out

on the oil wheal this 'striation sign' is an indication that sufficient solution has been injected Occasionally a larger amount, 5 to 6 c c, may be required if the mucosa is extremely lax

The three primary internal hæmorrhoidal areas to be injected are shown in *Fig* 244 As a general rule it is advisable to inject one of these at each session, but there is no set rule, and two or three piles may be injected at one session if thought advisable The injections are repeated at weekly intervals, and the aim should be to complete the treatment in three or four sessions The site of injection, the amounts injected, and results of treatment can be recorded by using the two-circle diagram shown in *Fig* 236

Fig 245—Correct site for injecting a hæmorrhoid (*From the author's Principles Practice of Rectal Surgery H K Lewis, and London*)

Occasionally a stronger solution of phenol, 20 per cent, in glycerin and water, may be injected into the lower pole of a vascular pile, either in combination with a submucous injection higher up, or at a subsequent treatment The dose is from 3 to 5 min

Bearing in mind that the object of the treatment is to produce a chemical sclerosis, the following practical hints should be observed —

1 Inject high up (*Fig* 245) When the injection is made too low, i e, beneath the epithelium of the anal canal, severe pain is produced and furthermore the formation of a fissure or abscess is likely to result

2 The needle must be gently and correctly inserted into the submucous layer If the needle is too superficial a white spot will be observed as soon as the injection is begun, in this case the needle should be passed in deeper or else removed and inserted at a different place Again, if the needle is thrust in too deeply, so that it reaches the muscle of the rectal wall, pain will result

3 Injection of too large amounts must be avoided or there will be a risk of necrosis and sloughing At the other extreme, injection of inadequate amounts will produce unsatisfactory results

4 Care must be taken when re-injecting a pile previously treated to avoid over-dosage When some fibrosis has developed the tissues are less tolerant and superficial necrosis is more liable to take place

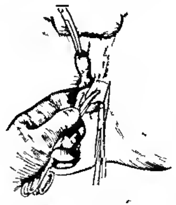


Fig 246—Ligature operation for hæmorrhoids Making the V shaped cut with scissors for the left lateral pile.

Complications after Injection —Massive thrombosis in the internal hæmorrhoidal plexus occurs rarely and is usually due to over-dosage, with rest in bed and hot applications to the anus the thrombosis gradually subsides Superficial necrosis will heal slowly, the ulcer should be painted through a proctoscope with 2 per cent aqueous mercurochrome solution Abscess formation and fissure are due to errors in technique

Operative Treatment.—Although numerous methods of removing hæmorrhoids have been described, the ligature operation has always been the most popular The method of ligature and excision described by Milligan et al in 1937 is correct anatomically and gives consistently better results than older methods

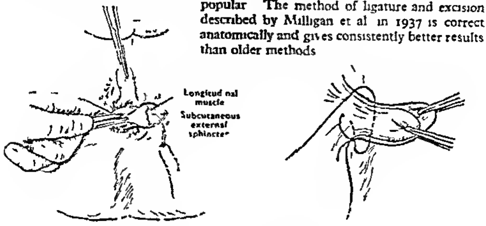


Fig 247—*Ligature of the pedicle of the p le*

A ligature operation is required for the cure of *intero-external hæmorrhoids* and for internal piles which have reached such a large size that prolapse and discharge are a *constant source of misery and discomfort*

The patient is placed in the lithotomy position after being anæsthetized with a general anæsthetic (inhalation or intravenous), or the operation may preferably be done under local or low spinal anæsthesia The three primary hæmorrhoids are taken in artery forceps, and when the external sphincter is properly relaxed, a little traction on each in its proper axis will enable a firm grasp of each pile pedicle to be obtained The incision to free each pile and prepare it for a ligature is made with straight scissors by the technique described by Milligan and co-workers a second pair of artery forceps is placed on the skin at the anal margin or on the skin tag related to each pile, and applying traction to both forceps with one hand a V-shaped cut is made with scissors as shown in *Fig* 246 a little blunt dissection now exposes the inner border of the subcutaneous external sphincter, and a ligature is applied to the pedicle of the pile at this level, the ligature may be an encircling one of stout silk, or a No 3 chromic catgut ligature may be passed on a *round bodied needle*, and the pedicle ligated by transfixion (*Fig* 247) By this technique the ligature is made to embrace the expansion of the longitudinal muscle, so that when the excess of ligated pile tissue is excised the ligature is prevented from retracting A ligature applied in this way not only secures the main branch of the

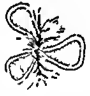
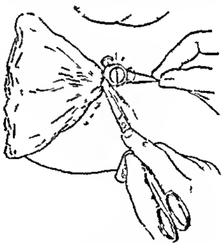


Fig 248—Appearance of the anus at conclus on of the operation.



F g 249—Gauze be ng tucked in at the s de of the anal tube

superior hæmorrhoidal artery and vein in the pedicle of each pile, but removes the dilated veins of the external hæmorrhoidal plexus which are related to each pile, together with venous channels connecting the internal and external hæmorrhoidal plexuses

Proceeding in this way the operator deals first with the left lateral pile, then the right anterior, and lastly the right posterior, in which case the forceps are held in the right hand and the cut is made with the left hand If secondary piles are present (usually on the left anterior and posterior, or left posterior aspects) a small scissors cut is made at the muco-cutaneous junction, and a catgut ligature applied separately As the final step of the operation, a little more loose or overhanging skin may need to be excised in relation to the external skin wounds, in order to leave flat surfaces which will heal by granulation (*Fig* 248) Sterile vaseline is injected from a collapsible tube, a short piece of rubber of ½ in outside diameter is inserted, and then a flat piece of gauze, moistened in dettol lotion is tucked into the anal canal on the lateral aspects of the tube (*Fig* 249) A pad of gauze and wool and a firmly applied T bandage complete the operation

OPERATIVE CURE OF ANAL FISSURE

This is one of the most important minor operations in this region A fissure which has become chronic and palpable, being usually associated with a sentinel skin tag, and often with infection at its base, cannot be cured except by operation

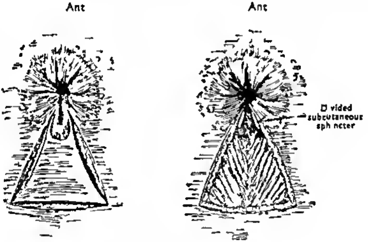


Fig 250—Showing the triangular incision and portion to be excised in the treatment of anal fissure

The operation itself requires a careful and considered technique, and the after-treatment is of great importance

Technique—With the patient in the lithotomy position, a triangular incision is made with a scalpel, as shown in *Fig* 250 The sides of this incision are about 1½ in in length from the anal margin The flap of skin enclosed by the incisions is lifted up with toothed dissecting forceps, and is dissected up towards the apex of the triangle in this way the sentinel tag, together with the fissure, is excised If a forefinger is passed into the anal canal at this stage a fibrous bar or ridge is felt traversing the anal extremity of the wound this is the contracted subcutaneous portion of the external sphincter, which should now be incised in the middle line with scissors, after doing this a portion of the di
may need cutting off on each side, and then a gentle digital often
helpful in restoring a normal calibre to the anus The result

wound along which a finger can be passed into the rectum without feeling any ridge or hindrance to drainage

Application of Tannic Acid.—Small bleeding points are compressed in artery forceps, and then, after drying the wound surface with dry gauze swabs, a 40 per cent solution of tannic acid in 1–1000 aqueous flavine lotion (*i e*, 20 g of tannic acid in 50 c c of lotion) is applied on gauze to the wound for a few minutes when it is seen that a brownish yellow surface coagulum has been produced, the operation is concluded by injection of sterile vaseline, insertion of a tube, and tucking in a flat gauze dressing in this case the dressing is of much importance, and serves to keep the skin margins flat

It may be noted here that the chief object of the open wound which is left after this operation is to secure drainage of the fissure, and if the surfaces of the wound are allowed to fall together in the immediate post-operative period, inadequate drainage will result to this end the tannic acid treatment is of assistance, partly because the surface coagulum reduces the likelihood of the wound surfaces adhering, and also it reduces the pain of the exposed wound, so that sphincter spasm after operation is consequently diminished

USE OF OIL-SOLUBLE ANÆSTHETICS

The injection of oil-soluble anæsthetics, such as proctocaine and percaine in oil, into the external sphincter ani and peri-anal tissues is a method of accepted value, the chief indication being the relief of anal spasm such as that caused by an acute fissure, or the post-operative spasm which may occur in ultra-nervous individuals after any operation on the lower rectum or anal canal

Technique.—The patient is placed in the right lateral position with the knees drawn up The posterior anal margin is shaved and the skin prepared with iodine A wheal of 1 per cent procaine is made an inch posterior to the anus The warmed oily anæsthetic solution (10 c c) is drawn up into a dry sterile Record syringe, and a 1½-in or 2-in No 20 needle attached *The operator's left forefinger is passed* into the anal canal as a guide, and the needle is inserted through the wheal, deeply into the sphincter on each postero-lateral aspect of the anus, the solution is slowly injected, care being taken not to puncture the lining of the anal canal, a few drops may be reserved in the syringe for injection beneath a dorsal fissure if present (*Fig* 251) As a result of this injection an almost immediate relaxation of the sphincter takes place, together with some local anæsthesia The sphincteric relaxation may last for several weeks *After operation upon the anal canal, notably for anterior fissure*, an injection of proctocaine often saves the patient a good deal of suffering, and renders the after-treatment easier

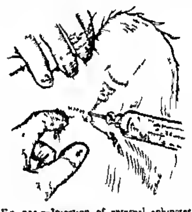


Fig 251.—*Injection of external sphincter* through anæsthetic wheal posterior to anus.

The subcutaneous injection of proctocaine or percaine in oil in the peri anal region is given in certain intractable cases of pruritus ani *The technique is to inject 10 to 15 c c* in a fan-shaped manner, chiefly on the posterior and postero-lateral aspects of the anus The solution is injected deeply into the tissues, and affects the sensory supply of the anus (inferior hæmorrhoidal and perineal branch of the 4th sacral nerve) Care must be taken to avoid ' pooling ' in the tissues, and at the conclusion of the injection the anal tissues should be massaged gently Re-injections are given according to indications, and as a rule the treatment should be completed in two or three sessions at intervals of a week During this time local treatment to clean up the anal dermatitis is taken in hand

CHAPTER XXXIII

RENAL FUNCTION TESTS

By E G B Calvert

The decision to carry out special tests of kidney function should always be based on the results of a thorough general clinical investigation, including, of course, an examination of the urine The diagnosis and prognosis of a case of renal damage can only be made after a careful summing up of all the findings, of which that for kidney function is but one

Of the characteristics of the normal kidney the most striking and the most important is its capacity to adapt itself to the requirements of the body When little fluid is taken, or when there is excessive loss of fluid by sweating diarrhœa, or vomiting a small volume of highly concentrated urine is passed, on the other hand, if the amount of fluid presented to the kidney is large a profuse flow of dilute urine results In advanced chronic renal disease the ability of the kidneys to form a concentrated or dilute urine, as the occasion demands, may be so reduced that little of the normal elasticity of function is left—eventually there may be fixation of the specific gravity of the urine at about 1010 (which is approximately the specific gravity of deproteinized blood plasma)

The process of concentrating waste products, which are being transferred from the blood to the urine, is the most important function of the kidney, and impairment of this function by disease is generally evident earlier than a defect in dilution Concentration power is regarded as directly proportional to the number of functioning nephrons (i e, glomerulo-tubular units), of which there are about 4½ millions in each kidney Ordinarily only a small percentage of the nephrons are at work at any one time, but when the load on the kidneys is steadily increased then more and more nephrons are brought into action until finally all may be engaged Therefore the *reserve power* is very large Indeed, it has been found that as much as two thirds of the total kidney substance may be destroyed before failure of function occurs With less damage of the kidneys there would be normal or adequate function, though the structural and functional reserves are reduced Under conditions of stress, however, the lower the reserve power the more likely are the kidneys to show impairment or failure of function Defective concentration may for a time be balanced by an increased volume of urine so that the total quantity of waste products excreted is sufficient to prevent their accumulation, above the normal level, in the blood Such a condition may be described as a *compensated impairment of renal function* When polyuria fails to prevent the accumulation in the blood there is a *decompensated impairment of renal function—i e, renal failure* The decompensation of a compensated impairment of function may therefore be caused by a prerenal deviation of fluid—for example, by cardiac failure or by excessive vomiting or diarrhœa Decompensation may also be brought about by increased protein catabolism, either endogenous or exogenous

It is the aim of function tests to discover the existence, and if possible the extent, of impairment of renal function by imposing extra work on the kidneys

and noting their response, but when these organs are already overloaded by an accumulation of excretory products in the blood, as in failure of function the further increase of such products should be avoided

Function tests may be employed to assess (*a*) The total renal capacity (*b*) The capacity of either kidney separately

TOTAL RENAL CAPACITY

The tests may be grouped as follows (1) Examination of the [illegible] Examination of the blood, (3) Estimation of the concentration an[illegible] powers of the kidneys, (4) The ability of the kidneys to excrete foreign sub[illegible] (5) The blood urea clearance test

1 EXAMINATION OF THE URINE

A systematic examination of the urine is of fundamental importance in every case of renal disease The volume and specific gravity of all specimens passed during the day and night should be noted, tests for albumin, blood, and other suspected abnormalities carried out, and an analysis made of the centrifuged deposit

The methods of examination and the significance of the results which may be obtained are described in Chapter VI

2 EXAMINATION OF THE BLOOD

In renal failure, whether permanent or transitory, there is in the blood an excess accumulation of certain urinary constituents, the chief of these being the non protein nitrogenous compounds This group includes urea, uric acid, and creatinine The concentration of inorganic phosphate, calcium, cholesterol, and plasma proteins is also altered in one or other type of renal failure

Urea —An estimation of the urea content of the blood is now regarded by most authorities as the best measure of nitrogen retention, its determination is easier, more accurate, and more informative than that of uric acid, creatinine or the total non-protein nitrogen

From what has been said on the subject of renal reserve power (*see* p 216) it will be clear that a normal concentration of urea, or of any of the other non-protein nitrogenous compounds, in the blood does not necessarily denote normal kidneys, on the contrary, the normal level may not be exceeded until there is destruction of about two-thirds of the total kidney tissue

If the samples of blood for urea estimation are obtained before breakfast the possibility of error from large amounts of protein in the diet is eliminated

The normal concentration of urea in the blood is from 20 to 40 mg per 100 c c, but after middle age an upper limit of 45 mg per 100 c c may perhaps be allowed

The blood urea is generally normal in chronic nephrosis, certain stages of the nephrotic forms of nephritis, focal nephritis, benign nephrosclerosis (benign 'chronic interstitial nephritis'), and in the kidney of pregnancy It is raised in acute diffuse glomerulo-nephritis secondary contracted kidney, malignant nephrosclerosis (malignant 'chronic interstitial nephritis'), acute renal failure of the 'crush syndrome' and of mismatched blood transfusions, obstruction of urinary excretion by the precipitation occasionally of sulphapyridine or sulphathiazole in the renal tubules, pelves, and ureters (when dosage high and output of urine low), severe ureteric obstruction from other causes, urethral (prostatic) obstruction, cases of marked congestion of the kidneys in heart failure, and in a group of cases known as extra renal azotæmia

By *extra renal azotæmia* is meant nitrogen retention which is not attributable to disease of the kidneys or to back pressure on them It occurs in pyloric or high intestinal obstruction in the alkalosis induced by the excessive use of alkali in the treatment of peptic ulcer, and in prolonged vomiting from other causes, also in severe diarrhœa continuous gastric lavage, diabetic coma, Addison's disease, and after much loss of blood as in severe gastric or duodenal hæmorrhage Dehydration and hypochloræmia are important features of these cases An extra renal azotæmia may, as not infrequently happens, be superimposed on a primary renal impairment or failure, and may, by aggravation of the latter, precipitate a fatal issue It is useful here to make the following distinction the azotæmia of renal origin is characterized by a blood of normal or high chloride concentration and normal or low alkali reserve (acidosis) and by a urine of low maximum specific gravity and urea concentration (*see* pp 219–221) and of normal chloride content, whereas in extra renal azotæmia there is a blood of low chloride concentration and, except in diabetic coma, often high alkali reserve (alkalosis) and a urine of normal maximum specific gravity and urea concentration and of low chloride content

In acute diffuse glomerulo-nephritis the blood urea may rise to very high figures—250 mg, or more, per 100 c c—and yet complete recovery occur Equally high concentrations in chronic nephritis may indicate a temporary exacerbation of the disease, or, more likely, a terminal phase of short duration In ureteric or urethral (prostatic) obstruction the blood urea is often brought from exceptionally high levels to normal, or nearly so, by operation

The above findings, including those in extra renal azotæmia, go to show that nitrogen retention is often not directly proportional to the amount of renal damage

In deciding the value of any blood urea result the amount of protein in the diet and the state of the circulation must be borne in mind—for example, in some cases of renal failure the blood urea may be greatly reduced, perhaps even to normal, by protein starvation, on the other hand, a rise in concentration may be partly or entirely due to congestive heart disease

There is no definite level of blood urea at which uræmia appears In chronic nephritis one patient may become uræmic at 140 mg per 100 c c, while another at the same figure, or even higher, may live in fair comfort for a year or more Uræmia, however, seldom occurs with a blood urea below 100 mg per 100 c c

On the surgical side blood urea estimations are of special value in cases of prostatic obstruction If the urea figures are above normal it is much safer to do a preliminary drainage, by suprapubic cystotomy or by means of an indwelling catheter, and postpone prostatectomy until a normal or almost normal blood urea has been reached

Uric Acid and Creatinine—The normal concentration of uric acid in the blood is 2 to 3 5 mg per 100 c.c and that of creatinine 1 to 1 5 mg They are both found in increased amounts in renal failure Rather than estimate uric acid and creatinine separately it is preferable to include them, along with urea and other non protein nitrogen, in a determination of total non protein nitrogen, the normal for this being 20 to 40 mg per 100 c c These figures should not be confused with the normal blood urea figures of 20 to 40 mg of urea per 100 c c, which expressed as urea nitrogen equal approximately 10 to 20 mg per 100 c c The estimations of uric acid and creatinine are given in terms of the substances themselves

Inorganic Phosphate and Calcium—The normal amount of inorganic phosphate is 2 to 3 mg per 100 c c, and of calcium 9 to 11 mg An increase of inorganic phosphate to 5 mg or over, or a reduction of calcium to 6 mg or under, is of very grave significance and generally means that uræmia is imminent if not already present

Cholesterol—The normal is 180 to 225 mg per 100 c c In chronic nephrosis and in the nephrotic type of nephritis, where there is a plasma protein deficit due to profuse albuminuria, the blood cholesterol is raised—perhaps to double or treble the normal amount

Plasma Proteins—As stated in the last paragraph, there is, in cases with marked loss of albumin in the urine, a lowering of the protein content of the plasma The fall is almost entirely in the albumin fraction, which may be reduced to less than 1 g per 100 c c The normal protein content of the plasma is albumin, 5 5 g per 100 c c , globulin, 2 0 g per 100 c c , and fibrinogen, 0 2 g per 100 c c

For the technique of the various kinds of blood analysis mentioned reference should be made to a manual on blood chemistry

3 ESTIMATION OF THE CONCENTRATION AND DILUTION POWERS OF THE KIDNEYS

Many tests have been devised for this purpose Among those which put the kidneys to extra effort the following may be selected as being effective and easy to carry out —

a **Urea Concentration Test** (MacLean and de Wesselow)—This is a test of the concentrating power of the kidneys

The patient, after emptying the bladder, takes 15 g of urea dissolved in 100 c c of water, flavoured with tincture of orange At one hour and two hours later the urine is collected for urea estimation According to MacLean and de Wesselow, if either specimen gives a percentage of urea above 2 the kidneys are held to be fairly efficient, and the higher the concentration the better the function On the other hand, in severe renal damage the concentration may not reach 1 per cent As there may be some diuresis during the first hour of the test it is generally better to rely on the second hour specimen If the volume of this specimen should exceed 120 c c a collection at the end of the third hour may be used, or the test repeated In patients with persistent diuresis the excess of volume must be allowed for in arriving at a result

A limitation of the test is that normal results are obtained in the œdematous forms of nephritis, even when severe in degree , apart from this the method has, as a rule, proved itself a valuable one in the examination of kidney function The test has been found to be more sensitive than a blood urea estimation, but very occasionally, however, the results fall within the normal in cases of azotæmia of renal origin

b **Range of Concentration Tests**—The range of urea concentration test and the range of specific gravity test (Calvert) arose out of work on the methods of Strauss and Graunwald, Volhard, and MacLean and de Wesselow Both tests investigate the 'flexibility' of renal function by estimating not only the power of concentration but also that of dilution, and over hours when these measures yield most information

1 *Range of Urea Concentration Test*—

The taking of fluid between noon and 7 o clock the next morning is forbidden, except for 3–4 oz. at lunch and 2–3 oz at tea time (4 to 5 o clock), none allowed with the evening meal at 8 o clock. At 10 p m the patient (an adult) is given the following

3 oz dose urea gr 240 (= 16 g or ℥iv), tr aurant, ʒss, and aq ad℥iij If the patient s age is between 3 and 12 years a half dose is given, if over 12 years a full dose An hour later (i e, at 11 p m), when any diuretic effect of urea will have passed off, the bladder is emptied and the urine discarded The patient is then kept warm in bed and encouraged to sleep All the urine is collected from 11 p m to 7 a m, the bladder being completely emptied at the latter hour, a specimen of this total collection is labelled 'A' and kept for estimation of its urea content Starting at 7 a m, immediately after micturition, the patient drinks, between 7 and 7 45 a m, a pint of water and a pint of weak tea containing little or no sugar, if thought advisable another half pint of water may be given at 8 a m, especially in hot weather—i e, 40 to 50 oz of fluid in all Cooling of the skin, by exposure, will aid diuresis The urine is collected from 7 a m to 8 a m., from 8 a m to 9 a m, and from 9 a m to 10 a.m, the three specimens, each labelled B, are kept for urea analysis

In cases where the percentage of urea in the blood has been found to be well above the normal (80 mg or more) the dose of urea may be reduced or omitted (*see* p 217, lines 1–3) Further, it is obviously unnecessary to give to waterlogged patients more than a little fluid—for example, only 10 to 20 oz

The range of urea concentration is represented by the 'maximum' concentration, as given in specimen 'A', and by the 'minimum' concentration, as found in the most dilute of the specimens 'B' The value of the maximum concentration as an index of function is greatly increased by comparing it with the minimum concentration—for example, maximum and minimum percentages of 2 0 0 2, respectively, indicate better function than a range of 2 0/1 2

As with other tests of renal function a considerable variation is displayed in normal results The distinction, however, from abnormal findings is readily made As a rule, the normal maximum concentration is 2 5 per cent or over, mostly 3, and the minimum 0 5 per cent or under In hot weather the minimum figure may sometimes be as high as 1 0 per cent, but the maximum will also be raised

A range of 4 8/0 3 means a greater degree of adaptability or efficiency than one of 2 8/0 5, though the latter is within the normal Occasionally in apparently normal persons who ordinarily pass a large volume of urine a range such as 1 8 0 1 may be found This, however, is in sharp contrast to the restricted range of severe renal impairment with the same maximum—for example, 1 8/1 1 In the terminal stages of chronic nephritis, without œdema, a very limited range of low concentration is obtained—for example, 1 3/1 2 In the dropsical forms of renal disease a restricted range of fairly good concentration is found, such as 2 4/2 1

The influence of failure of the circulation must be taken into account. With slow glomerular filtration the 'A' and 'B' concentrations are raised and their approximation varies directly as the degree of vascular-renal stasis

ii *Range of Specific Gravity Test*—This method is a simplification of the previous one and gives results of practically equal value A reliable urinometer is the only apparatus required The test is carried out in a similar way but no dose of urea is given and the specific gravity of the specimens is determined instead of the percentage of urea

In order to provide the kidneys with sufficient work (*see* p 216, last line) the patient should be put on as full a diet as possible with a high proportion of protein in the evening meal at 8 o'clock. It is advisable to collect the urine, as an additional 'maximum' concentration specimen, from just before this meal to 11 p m The 'maximum' concentration specimens (specimens A) are therefore from 8 p m to 11 p.m, and from 11 p m to 7 a m, and the dilution specimens (specimens 'B') from 7 to 8 a m., 8 to 9 a.m, and 9 to 10 a m

The 8 p m to 11 p m specimen should be examined for sugar Owing to the rise in specific gravity due to sugar the range of specific gravity test should not be applied to any patient with glycosuria, unless all the specimens of urine for the test can be obtained sugar-free by means of dietetic or other treatment

Albuminuria, even in marked degree, does not invalidate the test As ordinary urinometers are graduated for 15° C (or approximately a room temperature up to 20 C) the specimens ought to be allowed to cool before their specific gravity is taken The cooling of urine increases its specific gravity—for example, if 1015 when passed it may become 1018 on standing

In normal persons the maximum specific gravity (the more concentrated of the specimens 'A') is nearly always 1025 or over, and the minimum (the most dilute of the specimens 'B') 1005 or under Results like 1035/1003 indicate a high renal efficiency Maximum concentration readings between 1020 and 1015 must be viewed with suspicion unless the dilution figure is exceptionally low—*1002 to 1001 A restriction of range below 1020 points to renal inefficiency* —for example 1014/1006 The findings in the dropsical forms of kidney trouble are those of limitation at a moderate level, such as 1022 1019 or 1019/1017 The effect of circulatory failure on range of concentration results is referred to in the account of the previous test

Of chronic renal disease (considered apart from complications) it may, in general, be said that the lower the maximum concentration and the more restricted the range the worse is the prognosis, in the most advanced cases the specific gravity becomes *practically fixed at about 1010* (*see* p 216)

Both the range of urea concentration test and the range of specific gravity test will detect impairment of renal function before, frequently long before, failure is represented by a rise of the blood-urea

4 THE ABILITY OF THE KIDNEYS TO EXCRETE FOREIGN SUBSTANCES

The foreign substance employed is phenol-sulphone-phthalein (Rowntree and Geraghty)

The dye is injected intravenously or intramuscularly and the amount excreted in the urine over the course of two hours ascertained

A glass of water is given to ensure a good flow of urine About fifteen minutes later the bladder is emptied and 6 mg (1-c c ampoule) of the dye is injected as above After allowing five minutes for the beginning of the excretion of the dye all the urine is collected one hour and two hours later, and the volumes are measured In certain cases a catheter must be used

The specimens are made strongly alkaline with a solution of 25 per cent caustic soda, and from the red colour developed the amount of the dye excreted is estimated colorimetrically The standard colour, for comparison, may be made by diluting the contents of a 1-c c ampoule of the dye (1 c c, 6 mg) with water, or a mixture of water and normal urine, adding 25 per cent caustic soda solution as for the test specimens of urine, and making the volume up to a total of, say, 1000 c c

Normally, 40 to 60 per cent of the amount of dye injected should be obtained in the first hour, and 20 to 25 per cent in the second hour—that is, a total of 60 to 85 per cent in the two hours An excretion of under 40 per cent in two hours generally indicates serious renal damage In uræmia no dye may be excreted Very occasionally, however, a normal output is found in cases in which a considerable degree of renal impairment or failure is present The test is claimed to be of particular value prior to prostatectomy

The presence of interfering colours in the urine makes estimations difficult, while with obvious blood the method becomes impracticable

5 THE BLOOD UREA CLEARANCE TEST (MÖLLER, McINTOSH, AND VAN SLYKE)

In estimating the urea-excreting ability of the kidneys the importance of comparing the concentration of urea in the blood and the excretion of urea in the urine has long been recognized After much investigation it has been found that the relationship of these two values is best expressed by means of the blood-urea clearance test This test determines the volume of blood which, if it were completely ' cleared ' of urea by the kidneys, would yield the amount of urea excreted in the urine in one minute

It has been shown (Addis and Watanabe) that when sufficient urea and water are taken to produce a fairly large volume of urine the ratio of the amount of urea excreted per unit of time to the concentration of the urea in the blood is constant for the individual The ratio may be written as $\frac{UV}{B}$, where U = the percentage of urea in the urine, V = the number of c c of urine excreted per minute, and B = the percentage of urea in the blood

It is obvious that if the amount of urea (UV) excreted in one minute is divided, as in the above ratio, by the percentage of urea in the blood (B), the number of c c of blood from which UV could be derived (by complete ' clearance ') is obtained In the normal adult this volume of blood is, on an average, 75 c.c.

Austin, Stillman, and Van Slyke have demonstrated that the ratio only holds when the volume of urine is 2 c c (termed the ' augmentation limit '), or more, per minute With the volume of urine less than 2 c.c per minute the volume of blood ' cleared ' of urea per minute was found to vary directly as $\sqrt{V}$ The ratio then becomes $\frac{U\sqrt{V}}{B}$ In the normal adult the volume of blood calculated in this way is, on an average, 54 c c

Moller, McIntosh, and Van Slyke have applied the term ' *standard clearance* ' to the blood volume obtained by this latter ratio, and the term ' *maximum clearance* ' to the blood volume obtained by the former ratio

In the modern *blood-urea clearance test*, first described by these authors, both modes of clearance are recognized To repeat, the formulæ are

a Maximum clearance $(C_m) = \frac{UV}{B}$ In the normal adult the average is 75 c c

b Standard clearance $(C_s) = \frac{U\sqrt{V}}{B}$ In the normal adult the average is 54 c c

In the case of children, and of others whose size is considerably different from that of the average adult, the observed V should be multiplied by 1·73 and divided by the number of square metres of body surface (obtained from tables—by du Bois—for height, weight, and age)

The C_m formula is employed when the urine volume is 2 c.c., or more, per minute (as observed in the average adult or as corrected in children or others for body size), and the C_s formula when the urine volume (as observed or corrected) is less than 2 c c per minute. Both clearances are expressed as percentages of the average normal values (C_m = 75 c c, and C_s = 54 c c, as above)—that is, as percentages of the average normal renal efficiency

Technique of the Test.—As originally described, the procedure is to give the patient a glass of water and then collect the urine in two portions during consecutive periods of one hour each, a sample of blood is taken about the end

of the first hour From the urea contents of the blood and urine and from the volume of urine the blood-urea clearance is calculated in the way just explained It has been shown (Fowweather and others) that more accurate results are obtained if a dose of urea is given about an hour before the beginning of the test In cases, however, where the preliminary blood-urea figure has been found to be high (80 mg or more), the giving of urea is unnecessary The amount of water allowed in the blood-urea clearance test should only be such as to produce a moderate excretion of urine A large excretion, while lessening the liability to error from incomplete collection of urine, has the drawback that the estimation of a very low concentration of urea is not so exact

The following technique is recommended —

To avoid any complications due to food and exercise the test is done with the patient fasting and at rest, though a light breakfast without coffee may be allowed two hours previously

At 9 a m the bladder is emptied, and immediately afterwards 15 g of urea and a glass of water (8–12 oz) are taken At 10 a m , after another glass of water, the bladder is again emptied and the exact time recorded An hour later the first specimen of urine is collected, the time noted, and a third glass of water taken The second specimen of urine is collected at 12 noon The sample of blood for urea estimation is obtained just before or after the collection of the first specimen of urine

Two points require emphasis The bladder must be completely emptied from 10 a m onwards—by catheter in all women and in any man who has difficulty with micturition, also the exact number *of minutes over which each specimen is collected* must be known

Although no urea was given in the following case of renal disease it is selected as an example because it illustrates the use of both formulæ (C_m and C_s) —

A normal sized man aged 38

First specimen of urine —

Collected over 58 minutes, volume 128 c c , urea 0 800 per cent

Blood urea at the end of the first hour 40 mg per 100 c c (= 0 040 per cent)

As the volume per minute $= \frac{128}{58} = 2\ 21$ c c , the C_m formula is used

$$\frac{UV}{B} = \frac{0\ 800 \times 2\ 21}{0\ 040} = 44\ 20 \text{ c c}$$

The average normal for $C_m = 75$ c c Therefore, expressing 44 2 c c as a percentage of 75 c c, the patient's $C_m = \frac{44\ 2}{75} \times 100 = 58\ 9$ per cent of the average normal

Second specimen of urine —

Collected over 63 minutes, volume 113 c c , urea 0 900 per cent

Blood urea as above

As the volume per minute $= \frac{113}{63} = 1\ 79$ c c , the C_s formula is used

$$\frac{U\sqrt{V}}{B} = \frac{0\ 900 \times \sqrt{1\ 79}}{0\ 040} = \frac{0\ 900 \quad 1\ 34}{0\ 040} = 30{\cdot}15 \text{ c c.}$$

The average normal for $C_s = 54$ c c Therefore, expressing 30 15 c c as a percentage of 54 c c, the patient's $C_s = \frac{30{\cdot}15}{54} \times 100 = 55\ 8$ per cent of the average normal

The mean of the two estimations (58 9 per cent and 55 8 per cent), which should agree within 10 per cent of each other, is 57 3 per cent Therefore the blood urea clearance test shows that the patient's renal efficiency is 57 3 per cent of the average normal renal efficiency

The average normal renal efficiency is 100 per cent, with a range of 70 to 130 per cent Therefore any value of 70 per cent and over is counted as normal

For ages over 60 years, however, the lower limit of the normal may perhaps be extended to 65 per cent

The superiority of the blood-urea clearance test over the blood-urea alone has been demonstrated by Van Slyke, who showed in a long series of cases of renal disease that renal function, as measured by the clearance method, was always reduced to 50 per cent of the average normal (and in half the cases to between 40 and 20 per cent) before there was any rise of the blood-urea above normal

In acute diffuse glomerulo-nephritis the urea clearance may fall as low as 10 per cent (according to Van Slyke) and yet complete recovery occur Prognosis cannot be based on the test results during the first two months of the disease, but if no steady improvement is noticed by the end of the fourth month then progress downwards to the active chronic or terminal stage is almost inevitable As long as the clearance value remains above 10 per cent uræmia is unlikely to be present, but by the time the clearance has fallen below 5 per cent the patient is almost certain to be uræmic In secondary contracted kidney and in malignant nephrosclerosis the course of the disease may be followed fairly accurately by means of the test, while in chronic nephrosis a gradual lowering of clearance is not infrequently noticed and suggests glomerular destruction and a termination in uræmia

As regards operation in cases of prostatic obstruction, it is claimed (Riches and Robertson) that the blood-urea clearance test is a reliable guide, preliminary drainage should be carried out if the figure is below 60 per cent, as prostatectomy at this stage would be hazardous

Although the blood urea clearance test is generally considered to be the most sensitive method of examining renal function it should not be relied on alone, indeed it should not be employed unless the strictest accuracy in technique can be assured, as slight faults may produce serious errors in results A simple blood urea estimation ought always to be done and also a concentration test or one of the concentration and dilution tests Of the latter, the range of specific gravity test is not only reliable but also easy to perform

CAPACITY OF EITHER KIDNEY SEPARATELY

Before any decision can be reached with regard to nephrectomy, it is necessary to estimate the total renal capacity and also the capacity of each kidney The former is determined in the way already described, the latter by means of catheterization of the ureters and by excretory urography (*see* Chapter VII)

CHAPTER XXXIV

THE MANAGEMENT OF RENAL CASES

By Hamilton Bailey

Intake and Output of Fluid.—A special chart is kept of the amount of fluid the patient imbibes during twenty-four hours, and of the output of urine voided This must be kept with great care and accuracy

SUPPRESSION OF URINE (ANURIA AND OLIGURIA)

Often the patient looks and feels comparatively well until the condition is irremediable This is not the time to wait and see, nor one in which to strike a reassuring note It is a time for action, and the house surgeon should not relax his efforts unless the flow of urine has been re-established

We will assume that the anuria or oliguria is of the non-obstructive variety

Early Cases.—Have a blood-urea estimation performed Order copious intake of fluids and/or rectal drip of tap water Arrange to see the patient again in a few hours It should be noted that diaphoretics and hot packs are quite useless *Sweating merely depletes the patient of much-needed water and salts*

Severe Cases.—If the foregoing measures have proved ineffective, a serious view must be taken of the case The blood-urea estimation will be helpful in determining the measures to be employed

The best diuretic is an isotonic solution of sodium sulphate given intravenously by the continuous drip method An isotonic solution of sodium sulphate is made up by dissolving 42 85 g of Glauber's salts in one litre of water One must commence with caution, and stay with the patient to note the effect of the infusion If some urine is excreted, the rate of the drip is increased, and, to stimulate renal activity, heat can be applied to the loins If there is no response, it is wise to perform venesection *(see Chapter LXVI) before continuing with the sodium* sulphate solution

I generally give only one to one-and-a-half pints of the Glauber's solution, during the remainder of the twenty-four hours 5 per cent glucose rather than saline is employed, because it is well known that an excess of sodium chloride tends to damage *still further already damaged renal epithelium*

If improvement in the general condition and the outflow of urine is not manifest within six hours, a consultation with the surgeon should be held To perform further venesection necessitates blood transfusion, and transfusion in the presence of damaged renal epithelium is distinctly dangerous

HÆMATURIA

Severe hæmaturia from any cause, whether pre-operative or post-operative, should be the signal —

1 For a special chart to be kept of the pulse-rate every hour

2 For instructions to be given to the nursing staff that all specimens of urine must be saved and labelled with the time of voiding It is then possible to

compare one specimen with a previous one, and to form some rough idea as to whether bleeding is progressive or not

3 For blood grouping of the patient and tentative arrangements for a blood transfusion

4 For a careful watch that clotting is not occurring in the bladder Timely bladder irrigation will prevent extensive clot formation in the bladder and its attendant evils of sepsis and retention

MANAGEMENT OF AN INDWELLING URETERAL CATHETER

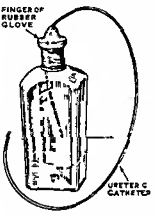


Fig 252 —A sterile collecting bottle improvised with the finger of a rubber glove and a medicine bottle

In some cases of acute pyelitis which do not respond *quickly to alkaline therapy*, an *indwelling* ureteral catheter is extremely good treatment A ureteral catheter is also retained in cases of leaks from the ureter It is the house surgeon's duty to see that an indwelling ureteral catheter is functioning Obviously, if the catheter is not providing free drainage it is obstructing the ureter, and is much worse than useless With a pyelography syringe the interior should be irrigated gently every few hours to prevent blockage The urine is allowed to drip into a sterile bottle (*Fig* 252), and urinary antiseptics must be given I have had several cases where a catheter has been kept in place satisfactorily for a week, but usually it should not be retained for more than twenty-four hours

MANAGEMENT OF A NEPHROSTOMY

Temporary nephrostomy is performed in many operations upon the kidney, particularly after nephrolithotomy The catheter in the renal pelvis allows irrigation of the renal pelvis Saline is employed for the first twenty-four hours It is best to instruct the nursing staff to use only a drachm or two of fluid, i e, just enough to make certain that the catheter is not blocked When it is assured that there is no hæmorrhage, a weak antiseptic solution such as 1–1000 mercurochrome can be used for irrigation with advantage If the mercurochrome solution is used earlier, it is difficult to be certain whether hæmorrhage is proceeding or not

As a general rule, a nephrostomy tube is retained for ten days At the end of this time the retaining stitch is cut, and by the twelfth day the tube is usually extruded If it is not, the house surgeon should remove it

ACUTE PYELITIS

The control of severe acute pyelitis by the injection of intravenous urotropine (Schering) is sometimes dramatic The temperature chart shown in *Fig* 253 illustrates an especially instructive instance, for the patient, in spite of treatment with alkalis and urinary antiseptics, continued to manifest severe symptoms for a fortnight One injection of intravenous urotropine had the extremely satisfactory effect shown in the chart Curiously, this form of therapy appears to be without value in chronic cases

Alkaline Treatment of Acute Pyelitis—Fluid must be given in large quantities, with a minimum intake of 5 pints a day The outflow of urine should

not be allowed to fall below 90 to 100 oz. Enough sodium citrate is given to render the urine alkaline to litmus. There is no fixed dosage, but during the first day or two it is necessary to give from 40 to 60 g every two hours up to a

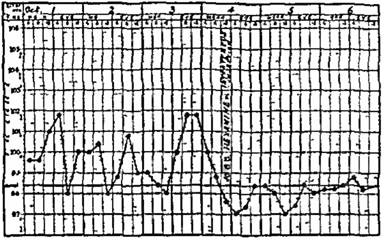


Fig 253—Temperature chart showing the dramatic effect of an injection of intravenous urotropine in a case of acute pyelitis

total of 300 to 400 gr in twenty four hours. Each specimen of urine is tested as it is passed, only when the urine becomes alkaline is the citrate reduced to 30 gr four times a day

URINARY ACIDIFIERS

If it is necessary to acidify the urine, the house surgeon should keep a careful watch on the reaction of the urine to see that the desired reaction is maintained. For many years sodium acid phosphate has been the standard urinary acidifier, but there are ever recurring cases where prolonged and liberal doses of this drug fail to alter the reaction of the urine

For acidifying the urine the following mixture can be recommended —

℞	Ammonium Benzoate	gr xv
	Glycerol	ʒss
	Chloroform Water	ad ℥ss
	T d s, p c.	

Alternatively, ammonium chloride is a splendid urinary acidifier, and it can be given in conjunction with hexamine in the following prescription —

℞	Ammon. Chlorid	gr xx
	Hexaminæ	gr x
	Ext. Glycyrrhiz Liq	♏xxv
	Aquam	ad ℥ss
	T d s p c	

Not only is ammonium chloride a better acidifier than sodium acid phosphate, but it possesses another great advantage. A mixture containing ammonium chloride and hexamine remains stable for two weeks whereas as is well known when sodium acid phosphate is used the hexamine must be prescribed separately

If neither of the above drugs produces acidification of the urine, the following mixture can be tried —

℞ Acid Nitrohydrochloric Fort *	♏ iv ss
Aquam Dest	ad ℥ iv

T d s, p c

ACIDOGENIC DIET

An acidogenic diet is of as much importance as drugs in these cases From the following items menus can be selected of which no patient could complain

Breakfast —Cereal or porridge, sugar, cream Eggs boiled, poached, or fried Bacon, kidney, cold ham, fish Bread and butter

Lunch —Beef mutton chicken, ham, liver, lean pork, veal, omelette, rice, macaroni, lentils, spaghetti Stewed plums, stewed prunes, cream Cheese and biscuits

Tea —Weak tea sugar, milk or cream Toast with butter Egg sandwiches, sardine sandwiches

Supper —Meat as for lunch Fish (salmon mackerel, herring, haddock, halibut), bread and butter, weak tea or small amount of coffee

URINARY ANTISEPTICS

There are a host of urinary antiseptics, and their choice is largely one of individual preference It is certain that many of them are of value in preventing urinary infection, and the house surgeon should not forget to prescribe one of the popular antiseptics in cases where it is of paramount importance to *prevent* infection, i e , after operation upon the urinary tract and in cases where catheterization has been employed

Hexamine (syn Urotropine) —Given by mouth, this has stood the test of time It has been in clinical use for over forty years In itself, hexamine has no bactericidal action but in an acid medium it decomposes with the liberation of free formaldehyde *The urine must therefore be well acidified*

Methylene Blue —This is an old fashioned remedy (1–4 gr in pill or cachet) Recent work has shown that this dye is as good as, if not considerably better than, many of the newer remedies in inhibiting bacterial growth in the urine

Neotropin —The usual dose is two dragees by mouth three times a day, with copious draughts of bland fluids It turns the urine a brilliant orange colour After four days' treatment there should be three days' rest

Acriflavine —Providing the urine is alkaline, and in an alkaline medium only, acriflavine exerts an antiseptic action against the colon bacillus and staphylococcus Acriflavine is administered in doses of 2 gr three times a day

All the above are useful, and it is a good practice to change the antiseptic after ten days or so In long standing cases of chronic *B coli* infections, the following special courses of treatment have to be instituted —

Ammonium Mandelate —The use of ammonium mandelate obviates the separate administration of ammonium chloride, which is necessary in other preparations of mandelic acid Preparations of ammonium mandelate are, amongst others, Mandelix (British Drug Houses) and Ammoket (Boot's Pure Drug Co) The dose of the former is 2 drachms four times a day in water, and of the latter 4 drachms The reaction of the urine must be tested regularly during the treatment, for it must be kept distinctly acid A reliable method is to add five drops of buffered methyl red to 5 c c of urine in a test tube The colour is bright red at *p*H 5 3, but is orange yellow if the reaction is too alkaline

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* It should be noted that it is nitrohydrochloric acid *fort* (U S P) which is used This can be obtained from Martindale s

It should be noted that the cost of a fortnight's treatment with mandelic acid is about 25s or more

Sulphonamide (*see* p 361)—A high concentration in the urine, although desirable, is not necessary in most cases A dose of 1 8 g a day with copious fluids usually produces favourable results The drug should be continued for a period of eight to fourteen days At the end of that time it is advisable to stop the drug, whether the urine has been sterilized or not After an interval of two or three weeks a second course can be given Sulphonamide preparations are cheaper than preparations of mandelic acid, they are also active over a wider *p*H range, although they are best administered in alkaline urine

CHAPTER XXXV

CATHETERS AND CATHETERIZATION

By Hamilton Bailey

Catheterization should be regarded with great circumspection—it is one of the house surgeon's most responsible duties Even when the patient requires to be relieved at an inconvenient time, any laxity in taking every precaution to ensure asepsis is unforgivable

Sterilization of Catheters—All modern catheters can be sterilized by boiling It should be appreciated that the modern gum-elastic catheter with due care will stand repeated boiling providing that it is carried out in the following way —

The catheter is plunged for two minutes into water already boiling It must be removed carefully by its wide end and dropped into sterile cold water or cold antiseptic solution

Preparation of the Patient.—Sterile towels must cover a wide area in order that the operator's hands and the shaft of the catheter may be protected from contamination The penis is grasped in a gauze swab moist with weak antiseptic The prepuce is retracted and the glans cleansed thoroughly with another moist swab Even this is insufficient The anterior urethra should be washed out in every case This is easily performed with a syringe filled with weak antiseptic The chosen catheter is lifted out of the lotion and lubricated by sterile lubricant. The penis is kept stretched vertically while the instrument is passed, and the watchword for urethral instrumentation is, as always, *arte non vi*

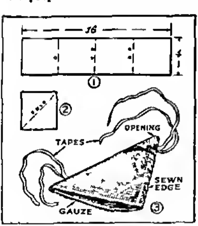


Fig 254.—An antiseptic penile jacket made from gauze and tape

Tying a Catheter.—Provided a catheter has been inserted under absolutely sterile conditions, and means are taken to prevent infection, a skilfully tied-in catheter is, in certain circumstances, an extremely satisfactory procedure A badly tied-in catheter, and/or one retained without every precaution to prevent ascending infection, is a menace to life

We will assume that the catheter has been introduced as it should be—perfectly aseptically The next thing to consider is how to protect the meatus from bacterial infection The best method is to apply an antiseptic penile jacket This can be made easily with gauze and tape (*Fig* 254) It is boiled before use and wrung out in flavine solution By this means infection alongside the catheter —a potential source of urethritis—is prevented

There are a large number of methods by which the catheter can be retained in the urethra One of those which can be applied over the penile jacket should be chosen

The Flexible Adhesive Plaster Method—A strip of wide adhesive plaster of such a length as to be double that from the base of the penis to one inch beyond the meatus, is nicked in its centre Through the nick is passed the catheter Half the adhesive plaster lies on the base of the penis and half on the dorsum The overlapping sides are pressed together The plaster is made to adhere to the skin at the base of the penis With a needle and thread the layers of the plaster are transfixed where it has been tucked The excess of thread is then bound tightly around the catheter, after which the plaster is again transfixed by the thread, and tied

The Pipe-cleaner Method (G B Davis) —A packet of 12 pipe-cleaners can be purchased for 1d, and the extra thick variety is the best They are sterilized by immersing them in spirit, and before use the excess of spirit is removed with a dry swab After the catheter has been passed, four pipe-cleaners are strapped with 1-in adhesive tape round the circumference of the penis as near the base as possible The four ends of the pipe-cleaners are brought to the catheter and fixed there with a very narrow strip of adhesive plaster in such a way that each pipe-cleaner has a definite bow and stands away from the glans penis (*Fig* 255) The ends at the base of the penis are then bent back, and any excess cut off with scissors Pipe-cleaners have the necessary rigidity to stand away from the penis and do not press upon the corona

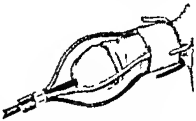


Fig 255—A method of tying in a urethral catheter using pipe-cleaners The penile jacket is not shown. (*After G B Davis*)

Foley's Bag Method—Particularly in patients who are intolerant of indwelling catheters, if a Foley's bag (*see* p 241) can be introduced with about 15 c c of inflation, they are usually very comfortable, as no mechanism for retaining the catheter in position is necessary

Management—It is, of course, futile to tie in a catheter aseptically, and then to let it discharge its contents into a bed bottle, infection will follow as surely as night follows day The catheter must be connected to sterile rubber tubing by a sterile glass connexion and led into a sterile bottle In order that the weight of the tubing shall not cause angulation of the catheter and meatal pressure ulceration, a strip of broad adhesive plaster across the thighs supports the penis and the catheter A stitch passed through the centre of the adhesive plaster and tied round the catheter will maintain it in the correct position (*Fig* 256) A better alternative to the bottle beside the bed is to connect the rubber tubing to a St Mark's apparatus for intermittent bladder irrigation (*See* p 238)

Indwelling Catheter in the Female.—The problem of the indwelling catheter is relatively simple in the case of a female By employing the refinements shown in *Fig* 257 a catheter may be kept in position for a considerable period without inviting urethritis or ascending infection

TREATMENT OF ACUTE RETENTION OF URINE

On no account should a patient with acute retention be catheterized in the casualty department and sent home He must be admitted

Providing the general condition is satisfactory, the time-honoured ¼ gr of morphia and a hot bath should be tried, in a very small proportion of cases *urine is passed into the bath*

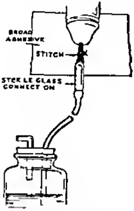


Fig 256—Method of supporting a tied-in catheter with a strip of adhesive plaster If the catheter is stitched to the adhesive plaster angulation and meatal pressure ulceration are prevented.

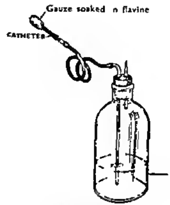


Fig 257—Method of managing an indwelling catheter in the female.

Retention due to Enlargement of the Prostate—This is the commonest variety and the one which requires the most careful handling The patient is elderly, the kidney function is probably impaired, and at all costs we must endeavour to avoid infection After the usual preliminaries, culminating in washing out the urethra, it is a good practice to instil some 4 per cent novocain into the urethra and wait four or five minutes It is improbable that a soft rubber catheter will pass the obstruction, it is better to employ a large-sized gum elastic bi-coude catheter at the commencement The difficult point to pass is where the middle lobe begins Occasionally the left index finger in the rectum may help to lever the tip of the catheter into the bladder (*Fig* 258) Once the catheter is in place only a few ounces of urine should be allowed to escape The *bladder is then decompressed slowly*

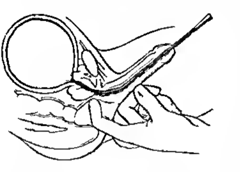


Fig 258—A finger in the rectum aiding the passage of the catheter in a difficult case of prostatic obstruction.

Decompression of the Bladder—Of all the methods of decompressing the bladder, I think the one of using an intravenous saline dripper is the method of choice Into the mouth of the catheter is inserted a nozzle—an ordinary glass nozzle serves the purpose, but the silver, right-angled connexion made for me by Mr Kipling (*Fig* 259) has many advantages The free end of the nozzle is connected to tubing (*Fig* 260)

Acute Retention due to Stricture of the Urethra.—To catheterize a strictured urethra is often exceedingly difficult, if not impossible. Only too often the patient arrives in hospital with his urethra bleeding and his retention unrelieved. I am convinced that the best method to try in these cases is not a

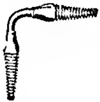


Fig. 259.—Silver catheter connecting link.

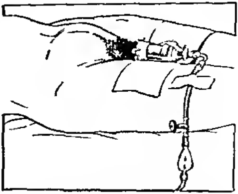


Fig. 260.—*Decompression of the bladder using the dripper of an intravenous saline apparatus*

catheter, but a small gum-elastic bougie, passed, if necessary, by the faggot method. The correct way of passing a filiform guide is by a gentle probing movement combined with rotation caused by rolling the guide between the finger and thumb (*Fig.* 261). Little, if any, damage can be done with this instrument, and if one can be insinuated through the strictures (they are often multiple), the *retention is relieved* in the best possible manner, viz. slowly, by the urine trickling alongside the instrument. Urinary antiseptics should be prescribed from the commencement of treatment in these and all other cases where acute retention *of urine is being relieved*.

Acute Retention where Attempts at Catheterization have Failed.—If, after a reasonable attempt with catheters, the bladder has not been entered, one of two courses must be adopted: (1) Suprapubic puncture; (2) *Suprapubic catheterization*.

Suprapubic Puncture with a Hollow Needle.—When acute retention of urine cannot be relieved by catheterization, and the circumstances are extenuating, suprapubic puncture with a hollow needle is a method which can be recommended. *If the circumstances remain* extenuating, and a catheter still cannot be passed, suprapubic puncture can be repeated. Repeated puncture is only permissible in exceptional circumstances, for to allow the bladder to refill after it has been punctured is dangerous; leakage is liable to occur into the cave of Retzius.

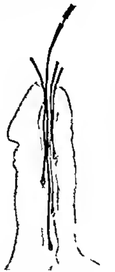
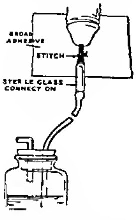


Fig. 261.—Finding the lumen of a strictured urethra with multiple filiforms. (*After F. S. Kell*)

The pubes are shaved and the skin of the lower abdomen sterilized. A lumbar-puncture needle is a convenient instrument to employ. Exactly in the middle line, one fingerbreadth above the symphysis pubis, a wheal of local anæsthesia is raised in the skin. Through this the lumbar-puncture needle is directed backwards and slightly downwards until the bladder is entered (*Fig.* 262). The needle is

Providing the general condition is satisfactory, the time honoured $\frac{1}{4}$ gr of morphia and a hot bath should be tried, in a very small proportion of cases urine is passed into the bath



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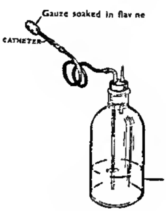

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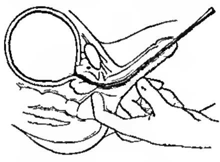

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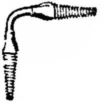


Fig. 259.—Silver catheter connecting link.

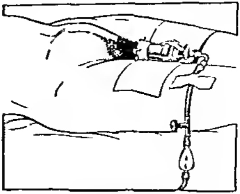


Fig. 260.—Decompression of the bladder using the dripper of an intravenous saline apparatus.

catheter, but a small gum-elastic bougie, passed, if necessary, by the faggot method. The correct way of passing a filiform guide is by a gentle probing movement combined with rotation caused by rolling the guide between the finger and thumb (*Fig.* 261). Little, if any, damage can be done with this instrument, and if one can be insinuated through the strictures (they are often multiple), the retention is relieved *in the best possible manner, viz. slowly, by the urine* trickling alongside the instrument. Urinary antiseptics should be prescribed from the commencement of treatment in these and all other cases where acute retention of urine is being relieved.

Acute Retention where Attempts at Catheterization have Failed.—If, after a reasonable attempt with catheters, the bladder has not been entered, one of two courses must be adopted: (1) Suprapubic puncture; (2) Suprapubic catheterization.

Suprapubic Puncture with a Hollow Needle.—When acute retention of urine cannot be relieved by catheterization, and the circumstances are extenuating, suprapubic puncture with a hollow needle is a method which can be recommended. If the circumstances remain extenuating, and a catheter still cannot be passed, suprapubic puncture can be repeated. Repeated puncture is only permissible in exceptional circumstances, for to allow the bladder to refill after it has been punctured is dangerous; leakage is liable to occur into the cave of Retzius.

Fig. 261.—Finding the lumen of a strictured urethra with multiple filiforms. (*After F. S. Kidd.*)

The pubes are shaved and the skin of the lower abdomen sterilized. A lumbar-puncture needle is a convenient instrument to employ. Exactly in the middle line, one fingerbreadth above the symphysis pubis, a wheal of local anæsthesia is raised in the skin. Through this the lumbar-puncture needle is directed backwards and slightly downwards until the bladder is entered (*Fig.* 262). The needle is

carefully held in position until the bladder is empty Relief of the retention lessens œdema and congestion around the seat of the obstruction Armed with this knowledge, four or five hours after the puncture, catheterization can be attempted again with renewed hope

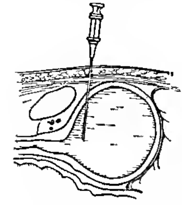


Fig 262 —Suprapubic puncture of the full bladder using a lumbar puncture needle.

Suprapubic Catheterization —When urethral catheterization has failed, an alternative to suprapubic puncture, which at the best is but a makeshift, is suprapubic catheterization In acute retention of urine, ordinary suprapubic cystostomy, which allows the urine to gush forth, must be avoided rigorously The aim is to introduce a mushroom-ended catheter into the bladder without spilling more than a few drachms of urine There are several ways of achieving this, but here is a description of the one which I have found to be the safest and most satisfactory

The essential apparatus is a No 28 reinforced Malecot catheter (*Fig* 263) The type of perforator shown in *Fig* 264 is inexpensive and a most useful instrument to possess The front of the distended bladder is exposed through a short suprapubic incision, and the bladder wall, with tortuous veins coursing over it, is clearly seen Local anæsthesia can be used most satisfactorily, but care must

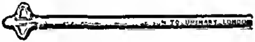


Fig 263 —A Malecot catheter The special reinforced model No. 28 is essential for successful use with the bladder perforator

be taken not to prick the distended bladder The bladder perforator is armed with the Malecot catheter, which is stretched over the perforator as shown in *Fig* 264 The end of the Malecot having been dipped in liquid paraffin, all is

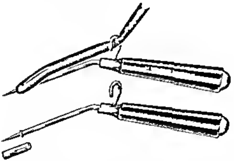


Fig 264 —Hamilton Bailey's bladder perforator to be used with a No 28 Malecot catheter

Fig 265 — A narrow bladed scalpel can be used as a bladder perforator in the absence of a special instrument.

in readiness for its insertion into the bladder This is done with a short, sharp stab The introducer is disengaged while the end of the catheter is pinched prior to clipping it with a hæmostat The catheter is pushed well into the

bladder, otherwise, as the bladder empties, the mushroom end is likely to be pulled up against the bladder wall Only a few drops of urine escape around the puncture. Sulphanilamide powder is blown into the wound, especially into the prevesical space Drainage of the prevesical space is provided, using a strip of corrugated rubber The abdominal wall is approximated with silkworm-gut sutures, not forgetting to anchor the catheter with one of these

If the special perforator is not obtainable, the Malecot catheter can be stretched over a narrow-bladed scalpel (Fig 265) This is not so satisfactory and requires some deftness, but in cases of necessity it serves the purpose

The catheter is connected with a dripper decompression apparatus precisely as described on p 232

Retention with Overflow.—However carefully treated by the usual methods, the mortality in these cases is appalling unless special precautions are taken After trying many methods, I am convinced that the following procedure is second to none No attempt is made to pass a urethral catheter A No 28 Malecot catheter is introduced suprapubically, as just described, it must be pushed well into the over-distended bladder Decompression is commenced *with the dripper running at 30 to 40 drops a minute* When the bladder is half empty, continuous intravenous sodium sulphate is administered, 1½ pints only being instilled at the rate of 30 to 40 drops a minute As soon as the intravenous drip is started the rate of escaping urine is increased to 50 to 60 drops a minute until the bladder is empty The suprapubic Malecot catheter is then disconnected from the dripper and connected with a St Mark's apparatus (p 238) A high fluid intake and suitable urinary antiseptics are prescribed

Retention as an Accompaniment of Acute Urethritis—Every means should be taken to relieve the retention without passing a catheter The patient should be placed in a hot bath, or made to sit in a hot sitz bath, and directed to pass his water in it If this is unsuccessful, an injection of hot water into the rectum may be tried If this fails also, the choice lies between passing a catheter under an anæsthetic and introducing a Malecot catheter suprapubically *My own view is that the latter procedure is much the better*

Retention Complicating Acute Prostatitis or a Prostatic Abscess—Again, when possible, catheterization should be avoided *To drain the bladder with a suprapubic catheter is correct treatment* If an abscess is present in the prostate, the abscess should be drained through the perineum

Clot Retention.—Blood-clot in the bladder sometimes causes acute retention The passage of a catheter relieves the retention, and repeated washings through a catheter of wide bore sometimes evacuate all the clot Blood-clot in the bladder is certain to become infected If the source of the bleeding is known, and it is estimated that there is a considerable amount of clot in the bladder, it is best to evacuate the clots by suprapubic cystostomy The measure avoids decomposition of blood and the attendant dangers of purulent cystitis

Retention due to Impacted Urethral Calculus.—Usually retention is only partial, but *the pain of a stone in this situation is intense* Systematic palpation of the course of the urethra usually reveals the site of the impaction, which is not infrequently behind a stricture or a narrow external urinary meatus Meatotomy will at once relieve matters *if the stone is impacted just behind the meatus* *In other situations, if a catheter* cannot be passed, the retention can be relieved by suprapubic puncture Before the bladder refills, the stone should be extracted through an incision in the floor of the urethra

Post-operative Retention.—Acute retention of urine after operations never occurs before puberty, and is more common in private than in hospital patients Proctoclysis definitely favours such retention *In dealing with this troublesome condition one should follow some logical therapeutic crescendo*

(1) *The rectal tube, if present, should be removed* (2) Potassium acetate, which is both a parasympathetic stimulant and a diuretic, is prescribed. ½ oz of 1–15

solution of liquor potassii acetatis by mouth This is repeated every half hour for eight doses if required Alternatively doryl, 1 c c subcutaneously, or 1 c c. of esmodil intramuscularly, can be tried (3) Psychological methods are invoked Assure the patient that there is no danger of organic obstruction, and suggest to him that if he cannot void urine in a given time a painful catheter may have to be used (4) Hot stupes to the hypogastrium, combined with supporting the lower abdomen with the flat of the hands, and in certain cases allowing the patient to put his knees over the side of the bed, is the next step to be tried (5) Catheterization naturally, discrimination must be used as to how long to persevere before the catheter is employed

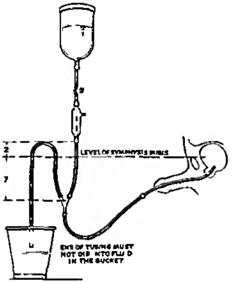


Fig 266 —Rationale of tidal drainage of the bladder (*After Laurie and Nathan*)

Retention from Paralysis (Lesion of the Spinal Cord)— The consensus of opinion is that catheterization should be avoided, for if it is used serious infection supervenes eventually Automatic emptying of the bladder can sometimes be established In the absence of facilities for tidal drainage, the best way of treating difficult cases is to perform *suprapubic catheterization*

Tidal Drainage—There are many modifications of the apparatus, of varying complexity The one shown in *Fig* 266 is the simplest The bladder is filled at a rate of 60 drops per minute *In cases of paralysis the height of the ∩ shaped tube leading from the Y connexion should be 2 in only above the patient's symphysis pubis* (*Fig* 266) When the bladder has become filled the level of the fluid rises in the system to this height, and then overflows the loop and runs down the tube into the receptacle, thus emptying both the bladder and the tubing by siphonage The process then restarts automatically The glass dripper must have a side tube which is left open The end of the outflow tubing must not dip in the fluid in the receptacle, and there must be no air in the catheter or the tube leading to it The tube leading from the Y shaped glass connexion should be of a larger bore than the other tubes When the automatic drainage has been proved to be working satisfactorily it can be allowed to function continuously The lotion used may be any bland bladder wash, and it can be used cold

CHAPTER XXXVI

THE MANAGEMENT OF BLADDER AND PROSTATIC CASES

By Hamilton Bailey

BLADDER WASHES

Bladder washes should be made up to a temperature of 110 F They cool considerably on passing through the tube of the irrigator Usually a receptacle holding 2 pints of the solution is suspended 3 ft above the level of the patient The following washes will be found of use —

Fig 267 —Washing out the bladder through a urethral catheter (After Sir William Wheeler)

1 Acriflavine 1–10 000

2 Mercurochrome 1 per cent or weaker

3 Potassium permanganate 1–2000

4 Silver nitrate 1–10,000 may be employed as an alternative to one of the above

5 Sulphanilamide 0 8 per cent in normal saline.

6 A saturated solution of boric acid diluted with an equal volume of sterile water

7 Acetic acid 1 per cent or phosphoric acid 1 per cent, the latter being the better in most cases of persistent alkaline cystitis

House surgeons have been divided into two classes—those who *stand at the foot of the bed and prescribe, and those who* take off their coats and wash out the bladder! I have found that the ones who take off their coats are more likely to adopt, and succeed in, the practice of surgery

Technique.—There are a number of ways of washing out the bladder, each with a field of usefulness —

1 *Through a Urethral Catheter* (Fig 267) —Some 3 or 4 ounces of the solution are run into the bladder The nozzle is withdrawn and the bladder allowed to empty

2 *Janet's Method* —This is carried out via the urethra without a catheter It is indicated almost exclusively when there is a suprapubic cystostomy and it is desired to irrigate *the prostatic bed A nozzle is applied to the sterilized* meatus After the anterior urethra has been washed out the nozzle is passed in more deeply, and sufficient hydrostatic pressure is used to overcome the contraction of the compressor urethræ The warm lotion flows up the urethra, irrigates the prostatic bed, and can be seen issuing from the suprapubic wound

3 *Through an Open Suprapubic Wound* —When the house surgeon carries out the bladder washes himself (the routine washes are carried out by the nurse or dresser) it is often advisable to remove the suprapubic box, if one is present This allows thorough inspection of the wound and the surrounding skin A

means of collecting the overflow is to employ a Thomson-Walker tray (*Fig* 268) After passing a large rubber catheter into the suprapubic wound, irrigation is continued until the wash is returned clear The house surgeon re-applies the box and gives any necessary instructions for its management

4 *Automatic Bladder Irrigation*—The simple apparatus illustrated in *Fig* 269 and first used at St. Mark's Hospital, revolutionized routine bladder irrigation It can be employed when a catheter has been tied into the urethra or when a mushroom-ended catheter has been sutured into the suprapubic wound It is not applicable in cases of open suprapubic cystostomy, nor is it advisable after Harris's operation with complete closure of the bladder

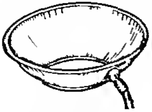


Fig 268—Sir John Thomson-Walker's tray

5 *Bladder Washes after Harris's Operation of Prostatectomy, with Closure of the Bladder*—Through the indwelling catheter 1 oz. of silver nitrate 1–10,000 or acriflavine 1–10,000 is instilled Irrigation beyond the amount necessary to ensure that the catheter is not blocked is to be deprecated, as it throws pressure on the suture lines and tends to cause leakage into the cave of Retzius Particularly during the first forty-eight hours, the house surgeon

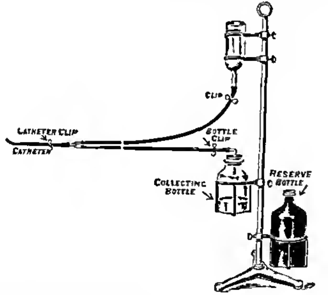


Fig 269—St. Mark's Hospital apparatus for bladder irrigation. *By merely releasing the appropriate clips on the tubing the bladder is filled with the wash. In the interval between the washes the urine drains into the bottle.*

must pay frequent visits to satisfy himself that the catheter has not become blocked If there is bleeding the surgeon should be informed at once It is highly important that the connexion of the catheter to the tubing and the urine-collection bottle should be strictly aseptic, and maintained so

* * *

If the house surgeon is called to see a patient of whom the nurse reports that the bladder wash, instead of coming through the suprapubic de Pezzer (or Malecot)

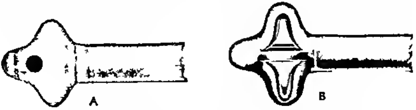


Fig 270 —A, De Pezzer catheter, B, Malecot catheter

catheter (*Fig* 270), is issuing from the drain in the cave of Retzius, it is possible that the eye of the catheter is blocked with blood-clot, but what is more probable is that the de Pezzer has come out of the bladder and is lying in the extravesical space This is liable to occur after suprapubic catheterization of a full bladder where allowance has not been made for the decrease in the size of the organ (*Fig* 271) A skin stitch holds the catheter rigidly in place Under these circumstances it is best to pass a urethral catheter if possible, and tie it in, and to remove the suprapubic de Pezzer, allowing ample drainage for the cave of Retzius If this course is not possible, the surgeon who performed the operation should be consulted at once

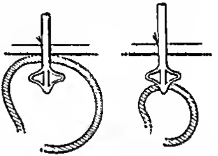


Fig 271 —Unless the expanded end of the catheter is pushed well into the bladder it will be dragged out as the bladder contracts, for the catheter is fixed to the skin by a stitch.

BLADDER DRAINAGE

Changing a de Pezzer Catheter.—It is unnecessary and unwise to change a de Pezzer catheter before fourteen days It is not until the lapse of three or four weeks, when the track is lined with granulation tissue, that the old catheter can be removed by a sudden sharp pull, and a new one, stretched on its special introducer (*Fig* 272), pushed down the track. Before there is a well-formed track the introduction of the catheter is a difficult and uncertain proposition It is best undertaken in the operating theatre by the person who performed the original operation

Fig 272 —De Pezzer catheter stretched on its special introducer ready for inserting into the bladder

* * *

Suprapubic 'Boxes'.—There are numerous pieces of apparatus for collecting urine from a suprapubic fistula They are all modifications of the Hamilton Irving

Fig 273—Macdonald's box

box Macdonald's box, which is illustrated in *Fig* 273, is light and easily adjusted

'Wick Drainage' is based on an entirely different principle A piece of gauze 1 yard square is taken, rolled, and drawn through a 34-in length of Paul's soft tubing The whole is then sterilized in the autoclave or by boiling With the wick thoroughly wet with sterile water or boracic lotion, the protruding end of the gauze is tucked into the sinus and spread about it The other end of the drain passes into the neck of a sterile bottle (*Fig* 274) The drain is held in place with safety-pins to the bed, and a ring of kaolin and vaseline around the wound edges completes the dressing A bed cage prevents displacement of the dressing Capillary traction carries away the urine as fast as it is excreted, in the same way as a lamp wick delivers oil to the flame Of course, the patient must remain reasonably quiet on his back in order to keep dry A fresh drain must be applied every four to eight hours, but the drain can be re-sterilized and used repeatedly By modifying the outlet of Macdonald's box to accommodate the wick, I have combined the advantages of both principles

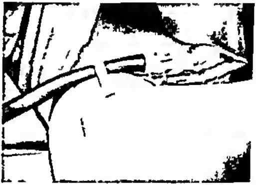


Fig 274—Thompson and Wright's lamp-wick method of collecting urine from a suprapubic fistula (*By kind permission of the Journal of Urology*)

ALLEVIATION OF PAIN IN CYSTITIS

Pain may be relieved by 4 oz of sterile liquid paraffin instilled into the bladder through a catheter Very often some of the paraffin is retained for as long as from five to seven days, during which time its soothing effect is exercised

HÆMORRHAGE AFTER PROSTATECTOMY

Harris's operation and transurethral resection have considerably minimized the incidence of this alarming complication Hot bladder washes are useful, and it should be noted very carefully that the temperature of the wash-out should not be more than 110° F when placed in the receptacle Preparations for a blood transfusion should be initiated at once

Pilcher's Bag—

Method of Use—If Pilcher's bag (*Fig* 275) has been inserted, the tube A should have the ligature imprisoning its contents released, and after pulling on the tube B to ensure that the bag is lying well within the prostatic cavity, a Higginson's syringe is fixed to the tube A, and two, or at the most three, syringefuls of water should be forced

into the bag, but no more The end of the tube A is then occluded with a hæmostat or a ligature A piece of tape or silk, long enough to pass over the bed rail at the foot of the bed, is attached to the tube B A bed-cradle prevents the tape becoming displaced by the bedclothes By this means extension is applied, ensuring retention of the bag within Cavity irrigation of the bladder is then continued

To Remove the Bag—The bag is usually removed forty-eight hours after the operation The contents of the bag are allowed to escape After the extension has been removed, it is highly important to sterilize thoroughly and to lubricate the tube B, for it is to be drawn through the urethra and the prostatic cavity The suprapubic drainage tube is removed after cutting the appropriate stitch, and probably one other stitch in the neighbourhood will have to be removed also By pulling on the tube A steadily the bag will be delivered into the wound and can be removed A rubber drainage tube is then passed into the cavity of the bladder and retained either by a stitch or a safety-pin

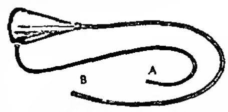


Fig 275—Pilcher's bag for controlling hæmorrhage from the prostatic cave after the prostate has been removed.

Foley's Bag—This apparatus is designed for use after transurethral resection of the prostate *The principles involved in its use can be seen in Fig 276*

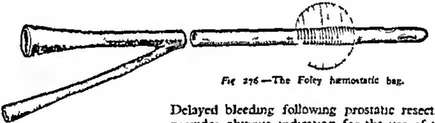


Fig 276—The Foley hæmostatic bag.

Delayed bleeding following prostatic resection provides obvious indication for the use of this instrument It is essential that the bladder be free from clots when the catheter is installed, for its walls are not sufficiently rigid to attempt evacuation of clots by forcible aspiration

RECORDS

It has repeatedly been pointed out in this work that diagrammatic representations of pathological findings and operative procedures are always of the highest value in the house surgeon's notes In the case of new growths of the bladder under intermittent treatment by cysto-diathermy, a diagrammatic representation of what is seen through the cystoscope *is almost* a necessity if the case is to be treated, as it should be, by a thorough follow-up (*Fig* 277)

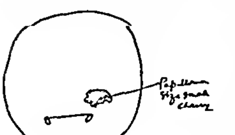


Fig 277—Facsimile from the record of a case of papilloma of the bladder

CHAPTER XXXVII

MINOR OPERATIONS ON THE MALE GENITAL ORGANS

By Hamilton Bailey

CIRCUMCISION

In a very Young Infant.—For a number of years house surgeons at the Royal Northern Hospital, London, who had had their training in Australasia, advocated, and performed very successfully, circumcision by means of a pair of bone forceps (*Fig* 278) This method has long been used in Australia for circumcision in young infants The penis is cleansed with soap and water The tip of the foreskin is grasped laterally by small Spencer Wells forceps, and enough traction is made upon it to allow a thorough breaking up of adhesions under the prepuce with a probe This part of the procedure must be done very thoroughly Exercising suitable traction on the now freed prepuce, the bone forceps are applied just distal to the glans with their V-shaped surface towards the baby There is momentary pain experienced, but it lasts only a few seconds After three minutes the superfluous tissue is severed with a sharp scalpel just distal to the instrument It will be found that there is no hæmorrhage and that the skin and the mucous membrane are sealed together throughout the circumference sufficiently to allow what remains of the foreskin to be placed gently behind the corona A dressing of tinct benzoini co is all that is required Healing occurs very quickly

Fig 278.—Type of bone forceps used in circumcision.

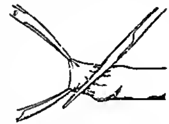
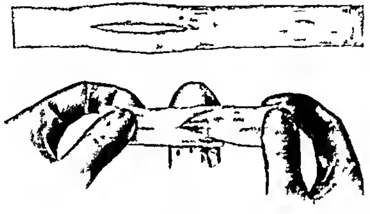


Fig 279.—Circumcision. Applying sinus forceps preparatory to excising the redundant skin.

In Older Children.—A general anæsthetic is given The prepuce is grasped in sinus forceps, which are inclined some what downwards (*Fig* 279) Redundant skin in front of the forceps is amputated with scissors The forceps are removed, and the skin retracts, displaying the preputial mucosa covering the glans A dorsal slit is made in this mucosal shroud, whereupon it can be peeled off the glans, smegma being brushed away with a swab The mucosa is now trimmed to within a quarter of an inch of the corona It remains to unite the cut edges of skin and mucosa to one another by fine, interrupted catgut sutures The first

Fig 280.—The three-in-one frænal stitch

of these sutches includes the severed frænal artery, which it is usually necessary to clamp early in the operation The three in-one frænal sutch (*Fig* 280) *is a neat method of securing this artery and approximating the skin and mucosa* at this point The dressing is preferably tinct benzoini co, applied on a narrow strip of gauze Alternatively, a vaseline gauze tourniquet applied as shown (*Fig* 281) can be used



A

B

Fig 281 —A Tourniquet dressing for circumcision B Method of applying the dressing

In the Adult—It is far best performed under local anæsthesia which is hly satisfactory (*Figs* 282, 283)

When the Prepuce cannot be Retracted—After cleansing the area thoroughly, 1 per cent novocain is infiltrated into the foreskin as far back as a quarter of an inch behind the corona The patient only experiences pain on the first prick of the needle, which is driven in by a sharp stab, at the point shown in *Fig* 282

Fig 282 —Method of anæsthetising the prepuce when it cannot be retracted.

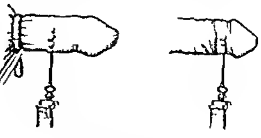


Fig 283 —Method of anæsthetising the prepuce when it can be retracted.

Via this puncture the whole of the prepuce is ballooned with the local anæsthetic It is sometimes advisable to make a second puncture to infiltrate the frænum

When the Prepuce can be Retracted—Grasping the edges of the prepuce in hæmostats, a dorsal slit is made to within a quarter of an inch of the corona

A hæmostat is then placed on the frænum and the requisite amount of prepuce is excised In this connexion it is well to note carefully that it is preferable to excise too little than too much The ideal circumcision should provide just enough skin to surmount the corona Suturing the mucous membrane to the skin is accomplished in exactly the same way as in the child Priapism is obviated, as also is the likelihood of post-operative hæmorrhage and infection, if the following dressing is applied carefully Sulphanilamide powder is blown upon the suture line A well-lubricated glass rod is introduced into the mouth of the urethra while the dressing is applied and it is not removed until the dressing is set The dressing consists of a narrow gauze bandage well soaked in mastisol The entire penis is bound up (*Fig* 284), after which the glass rod is removed At the end of ten days the dressing can be removed easily by splitting it with scissors

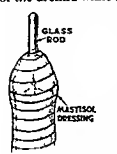


Fig 284 —Technique of the mastisol dressing

The operation is quite painless, but priapism usually follows in a few hours A full dose of bromide (gr xxx) should be prescribed, and a good method is to provide an intelligent patient with an ethyl chloride spray, which he can use as the need arises

Hæmorrhage after circumcision usually occurs from the region of the frænum The three-in-one frænal stitch minimizes this untoward occurrence Further, it can be used with advantage to stop bleeding in the area When bleeding is coming from any part of the cut surface, an interrupted stitch or two will usually control the hæmorrhage, especially when ribbon gauze soaked in *tinct benzoin co* is wrapped around the region of the corona When persistent bleeding occurs after circumcision, hæmophilia should be suspected, and measures taken forthwith to supply an adequate amount of prothrombin.

INCISION OF THE FORESKIN FOR BALANITIS AND CHANCROID

It is most unwise to perform circumcision in cases of balanitis and soft sores, but if the patient has phimosis it is necessary to expose the glans

Evipan anæsthesia is advised, and instead of the usual dorsal slit, it is better to make two incisions, one on either side of the penis, so as to expose the pockets on each side of the frænum A grooved director is inserted under the foreskin, and upon this the mucous membrane and skin are slit with scissors from the free margin to the back of the corona

PARAPHIMOSIS

In early cases the following can be tried the end of the penis, including the strangulating band, is wrapped in a bed of cotton wool soaked in a mixture of 0 1 per cent adrenaline and 10 per cent cocaine The compress is kept in position for ten to fifteen minutes On removal of the compress the œdema will be found to have abated considerably, and a little traction often restores the prepuce to its normal position

If this measure does not prove successful, gas or evipan anæsthesia should be administered A nick is made in the constricting band (*Fig* 285) and the

paraphimosis forcibly reduced (*Fig* 286) In all cases of paraphimosis circumcision should be performed as soon as the inflammation has subsided

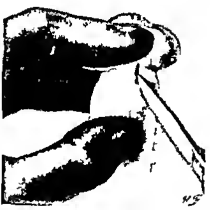


Fig 285 —Paraphimosis Nicking the constricting band

Fig 286 —Forcibly reducing a paraphimosis

MEATOTOMY

Meatotomy is a minor operation which if correctly performed gives much satisfaction It is indicated when the meatus is too small to allow the passage of instruments, and in cases of pin hole meatus giving rise to symptoms I S Koll gives the following instructions The frænum of the glans penis is infiltrated with novocain (*Fig* 287 A) The cut is then made with a scalpel introduced into the meatus for a distance of about one centimetre directing the blade slightly to one side of the middle line the better to avoid the frænal artery (*Fig* 287, B) The mucous membrane of the cut edges is then joined to the skin of the glans by

fine interrupted No 00 catgut sutures (*Fig* 287, C) This secures prompt hæmostasis and prevents any subsequent closure of the incision

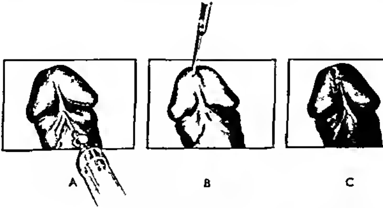


Fig 287—Meatotomy A, Infiltration of the frænum, B Introduction of the scalpel C Suture of the cut edges. (*After I S Koll*)

ANÆSTHETIZING THE URETHRA

To be able to anæsthetize the urethra effectively is a very valuable acquisition The urethra is irrigated and 2 drachms of 4 per cent novocain are introduced by means of a urethral syringe (*Fig* 288) The syringe is removed and the solution is prevented from running out by pinching the lips of the meatus together (*Fig* 289) The penis is then grasped with the left hand so as to force the solution

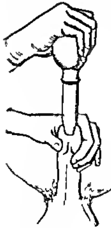


Fig 288—Injecting local anæsthetic into the urethra.

Fig 289—Anterior urethra distended with local anæsthetic solution.

Fig 290—Massaging the local anæsthetic solution into the posterior urethra. (*Figs* 288 290 *after Sir William Wheeler*)

backwards The right hand massages the solution into the posterior urethra (*Fig* 290) When the meatus and penis are released no fluid should escape One more drachm of novocain is injected into the anterior urethra, a penile clamp applied After a lapse of five minutes the penis is again

removed, and the fluid once again massaged into the posterior urethra A further drachm is introduced

The whole process takes from ten to fifteen minutes If good results are to be expected one must be patient

DILATATION OF A URETHRAL STRICTURE

Efficient lubrication of urethral instruments is of great importance A good method is to fill a tall, narrow beaker with biniodide solution 1–4000, and pour into it several teaspoonfuls of liquid paraffin, which will float on the top The instrument is lubricated by the floating oil as it is withdrawn

Before any urethral instrument is passed, the glans should be cleansed carefully and the urethra irrigated with weak antiseptic solution

Gum-elastic Bougies.—If the house surgeon is inexperienced in urethral instrumentation he will be well advised to confine his activities to the gum-elastic bougies The penis is grasped behind the glans, and is kept on the stretch

Fig 291 —Passage of a urethral sound The *tour de maître*

The bougie is introduced If the point is arrested it is withdrawn a little, and again pushed onwards If the attempt fails, a smaller instrument is selected, and so on, until the size which will pass is reached In attempting to pass a bougie through a fine stricture filiform bougies are employed They should not be resorted to until the operator is satisfied that he is *really* dealing with a fine stricture The 'faggot' method (*see Fig* 261, p 233) is often useful

Two, three or four guides are introduced until one finds the opening The correct way of passing a filiform guide is by a gentle probing movement combined with rotation

Metal Bougies.—The passage of metal bougies requires a little experience and a very light hand The *tour de maître* is shown in *Fig* 291 No force should be used

THE INJECTION TREATMENT OF HYDROCELE

The patient is recumbent After transilluminating the hydrocele, the skin of the scrotum is sterilized with picric acid Grasping the neck of the scrotum with the left hand, the skin is made tense over the swelling Using 1 per cent novocain, a wheal is raised in the skin at a convenient point A large lumbar puncture needle (Barker's) is passed into the sac as far as possible without striking the testicle The needle and the anæsthetized scrotal skin are then grasped in a fine pair of Spencer Wells forceps (*Fig* 292) so as to ensure against the needle

ping The hydrocele fluid is allowed to run out into a bowl, or it is aspirated fitting a syringe on to the base of the needle When the sac is empty, the icle is palpated to obviate the possibility of overlooking the primary cause of hydrocele Using an aspirating syringe, the sac is washed out with saline

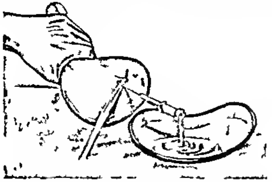


Fig 292—The injection treatment of hydrocele. Evacuating hydrocele fluid. Note the method of preventing movement of the lumbar puncture needle

order to rid the interior of any albuminous material Some 2 to 3 c c. of nine urethane are injected into the sac, the needle is withdrawn, and the otum is gently massaged, so that all parts of the sac some into contact with the ition The puncture is sealed with collodion, and the patient is given a pensory bandage

He is instructed to report in a week's time Usually, on the second visit hydrocele appears as large as ever, and the patient should be warned of this bability The process is repeated, using 3 to 4 c c of quinine urethane the case of a large hydrocele a third injection is usually necessary

The patient then reports at weekly intervals, and it is found in most cases : although the fluid reaccumulates it is gradually absorbed, and that the rocele has disappeared by the end of three weeks after the last injection

I have treated a large number of cases by this method, and have had favourable ilts in over 80 per cent of cases There seem no definite criteria as to which : is going to respond to injection treatment and which is not, but on the whole may say that very large hydroceles are better treated by operation

Unilocular cysts of the epididymis also respond to injection therapy, but y must be unilocular If, as is often the case, they are multilocular—i e, y do not completely empty on being aspirated— injection treatment should be employed

THE INJECTION TREATMENT OF VARICOCELE

The injection treatment of varicocele is sometimes effective in small or derate sized varicoceles One treatment is all that is necessary

TECHNIQUE —The neck of the left side of the scrotum is shaved and the skin repared with picric acid A wheal of local anæsthetic is produced in the skin e patient stands, and a small bunch of veins is taken up between the finger and mb Using 2 c c. of a 5 per cent solution of sodium morrhuate in a syringe ted with a particularly sharp needle, the injection is made from above down ds, just below the external abdominal ring (*Fig* 293) The pampiniform cus is entered at several points by a few short jabs of the needle The patient

lies down, and the puncture is sealed with collodion The pain occasioned by this treatment is often quite severe, and there is sometimes a considerable reaction It is well to keep the patient lying on a couch for an hour, and then advise him to go home and rest for twenty-four hours A suspensory bandage should be worn for a month

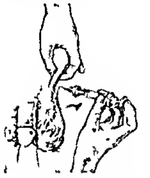


Fig 293 —The treatment of varicocele by injection

Fig 294 —Diagram to illustrate prostatic massage

MASSAGING THE PROSTATE

To be able to massage the prostate effectively is useful for both diagnosis and treatment After the patient has passed urine he assumes the knee-elbow position The gloved finger is inserted into the rectum, and gently the prostate and vesicles are massaged in the direction shown in *Fig 294* After a minute several drops of fluid will drip from the meatus These are collected on a slide for microscopical examination

CHAPTER XXXVIII

TREATMENT OF BRUISES AND SPRAINS

By A G TIMBRELL FISHER

THE treatment of sprains and allied injuries is of considerable importance, both to the house surgeon and the practitioner, for thousands of working hours are lost and much prolonged disability results from ineffective treatment of these injuries

BRUISES

A contusion often results in the subcutaneous escape of blood from the capillaries and an ecchymosis develops In more severe cases a hæmatoma, the result of subcutaneous injury to a vein, occurs rapidly When considerable bruising follows a minor injury, the possibility of hæmophilia, or delayed coagulability of the blood, should be suspected It is not unusual for a bruise to appear at some distance from the site of the injury, particularly when the latter affects the deeper tissues, in such cases blood has travelled to the surface along fascial planes The familiar colour changes in bruises are due to disintegration of hæmoglobin. Clotting in a hæmatoma usually first occurs at the periphery, the fluid centre being absorbed more gradually In subpericranial cephalhæmatoma this often causes difficulty in diagnosis (*see* p 166) Occasionally, a hæmatoma suppurates

Treatment.—Usually, the associated injury to ligament, muscle, etc, is the principle consideration, and the bleeding (bruising) requires no special treatment. Bruising can sometimes be limited or prevented by applications of cold water, ice, or evaporating lotions A strong solution of freshly prepared ammonium chloride, or of liquor plumbi subacetatis, applied on lint, is sometimes of value Firm pressure by bandaging over a layer of wool, or by strapping, may be combined advantageously with these applications

Special Bruises—Occasionally a hæmatoma confined by deep fascia causes severe pain. In such cases the blood requires evacuation either by aspiration, or, rarely, by open operation

Hæmorrhagic effusion into a joint only needs aspiration if it is excessive and is causing much pain and tension Such a procedure should always be carried out with the strictest attention to aseptic ritual It should be noted that aspiration of a traumatic effusion into a joint is very seldom necessary, as in most cases absorption occurs with a combination of firm bandaging of the joint combined with gentle active movements, which, in the lower extremity, should be at first non weight bearing

In hæmorrhage associated with muscular sprains or ruptures the effused blood may spread in intermuscular planes, and subsequent organization of the clot may cause troublesome adhesions, with painful limitation of certain movements This sequel can sometimes be prevented by massage and by early movements, and for its treatment manipulation under anæsthesia is often of great value

An ecchymosis or hæmatoma may be associated with a ligamentous or muscular sprain or rupture A severe ligamentous injury, or fracture into a joint, may be associated with intra articular hæmorrhage or hæmarthrosis

SPRAINS

A sprain may involve a ligament, muscle, or tendon, and usually follows overstretching from some sudden movement which is frequently of a twisting nature It is associated with rupture of some of the muscular or connective-tissue fibres, and hence with more reaction than in cases of simple *strain from minor* injuries, or the chronic ligamentous strain often associated with deformities (e g , chronic sacro iliac or lumbo sacral strain)

The first lines of defence of a joint are the muscles which act upon it, and a ligamentous sprain may be due to some sudden movement when the muscles are momentarily taken unawares, or, in more severe cases, to failure of the muscles to counter the strain The knee, ankle, shoulder, and wrist are frequently involved

Diagnosis —Pain, swelling, and tenderness are always more marked over the affected ligament, often at one or other of its attachments Movements of the joint which stretch the damaged ligament are painful and restricted by reflex muscular spasm In many cases ecchymosis occurs, and, in the more severe, hæmorrhagic effusion into the joint (hæmarthrosis) usually follows In the knee, limitation of extension following sprain and due to spasm of the flexor group of muscles must be carefully distinguished from that due to a mechanical block, as occurs in unreduced fracture dislocation of a semilunar cartilage

X-ray examination should never be omitted in any severe joint injury Many sprains are associated with fracture Common examples are sprain of the internal lateral ligament of the knee with separation of a small bony fragment from the internal femoral condyle, fracture of the external malleolus associated with sprain of the external lateral ligament of the ankle, and injuries to the great tuberosity of the humerus in sprains in the shoulder region

Rupture of a ligament is a more serious condition, and the signs mentioned above are increased It is associated with hypermobility of the joint , for instance, in complete rupture of the internal lateral ligament of the knee joint there is no impediment to abduction of the leg in relation to the thigh Diagnosis of rupture is facilitated by the local injection of an anæsthetic, such as 2 per cent novocain, to abolish muscular spasm, which might otherwise mask the presence of hyper-mobility The differential diagnosis of sprain and complete ligamentous rupture is of fundamental importance, for if the latter condition is overlooked great disability surely follows

Treatment —Success depends upon a judicious combination of rest and movement A sprained ligament cannot be repaired if the damaged fibres are subject to constant fresh injuries On the other hand, if a sprained joint or tendon be kept completely at rest for too long a period, repair of the ligament takes place at the expense of (*a*) muscular wasting, and (*b*) adhesions Active movements of the affected joint or of the tendons or muscles that pass over the joint must be commenced from the first, but in such a manner that no strain is placed upon the ligament or tendon undergoing repair

Example Sprain of External Lateral Ligament of the Ankle-joint —Neglected cases are often seen in which persistent tenderness exists over the affected portion of the ligament with pain and swelling during exercise, a persistent slight

limitation of inversion of the foot, and a complaint of periodical ' giving way " of the ankle In such cases, repair of the ligament has become associated with contracted scar tissue or adhesions, the formation of which the practitioner must always endeavour to prevent

In slight cases, with little or no swelling, the ankle is strapped with overlapping strips of flexible adhesive plaster which extend from the outer border of the foot in an upwards and inwards direction, but do not completely encircle the ankle-joint The outer side of the heel of the shoe on the affected side should be reinforced by a wedge of leather a quarter-of-an-inch in thickness While the external lateral ligament is thus relieved from strain, gentle exercise in the form of walking may be allowed An alternative method is firm bandaging of the joint over a thick pad of wool, placed over the damaged ligament This method has the advantage that it facilitates such physical measures as massage and assisted movements, preceded by radiant heat, infra red, galvanic, or hot saline, foot-baths If the services of a skilled physiotherapist are available, these should be enlisted

In more severe cases, considerable bruising and swelling are present, and provided associated fracture or complete ligamentous rupture have been excluded, treatment should be as follows Rest from weight-bearing at first, with application of cold compresses or evaporating lotion Superficial massage (effleurage) assists in relieving pain and in the diminution of swelling, and in the intervals the joint is firmly bandaged When pain, swelling and bruising have largely subsided, treatment is continued as for minor degrees of sprain

Rupture of External Lateral Ligament of Ankle—In such cases repair obviously necessitates a longer period of freedom from strain upon the damaged ligament Treatment should at first be upon the same lines as for severe sprain When swelling has partially subsided, the ankle is encased in plaster of Paris, which extends from the roots of the toes to the upper third of the leg, and the patient is encouraged to walk. At the end of a month, the plaster is removed and a crepe bandage substituted, which is removed daily for radiant heat and massage

Treatment on similar lines is adopted in cases of sprain fracture of the ankle It has been shown by Bohler and others that, owing to the movement of the tendons passing over the joint, such ambulatory plaster treatment is neither complicated by the formation of adhesions nor does muscular wasting occur to any appreciable extent

In cases of sprain Leriche recommends infiltration of the damaged ligament with novocain, and claims that this measure, by its effect upon the reflex arc, limits effusion and reduces the period of incapacity

In severe sprains of the shoulder, the arm should be placed on a splint in abduction and external rotation, as these movements are apt to be restricted by adhesions if the arm be kept by the side

Muscular or Tendinous Strains and Ruptures—Strain of a muscle or tendon involves its attachment to bone, from which a variable number of the muscular or tendinous fibres may be torn away, with some damage to the periosteum Sometimes a portion of the bony attachment may be wrenched off by muscular action Such muscular strains are common, both in sport and in various industrial occupations (' tennis elbow ', rider's strain of the adductor longus, etc) Actual rupture, either partial or complete, of a tendon or muscle is a more serious lesion and may occur almost anywhere in its course, but more

commonly at the junction of the muscle and its tendon Partial rupture of the rectus femoris commonly occurs in football players or a transverse tear of the muscle and tendon may occur near its patellar attachment Rupture of the long head of the biceps or of its tendon, and similar injuries to the supraspinatus tendon, the tendo Achillis, or the plantaris tendon are all common injuries

Diagnosis —Sudden acute pain during some strenuous exercise is accompanied by immediate loss of power, and followed by swelling, tenderness, and bruising In rupture of muscle, if superficial, a gap may be felt, and on attempting to contract the muscle a characteristic rounded swelling appears in the course of the muscle and proximal to the tear Hæmorrhage may be diffuse and involve intermuscular planes or take the form of a localized hæmatoma

Passive movement in the line of action of the injured muscle is comparatively painless, but active movement is restricted or inhibited, painful, and accompanied by the signs mentioned above

Treatment —A muscular or tendinous strain, if slight, is best treated by massage and support in the form of a bandage or strapping, and, as in ligamentous sprain, the avoidance of those movements which stretch the damaged parts In cases of chronic strain associated with localized pain and tenderness such measures as infra-red rays, ionization, or diathermy are often of value, or, in obstinate cases, the injection of novocain In those cases associated with adhesion formation, manipulation under local or general anæsthesia may be of great value In more severe cases, the principles of treatment resemble those for severe ligamentous sprain, viz , avoidance of strain upon the damaged parts until repair has taken place combined with such functional use as does not interfere with this principle

Examples Severe strain of the deltoid should be treated with the arm in the abducted position , in sprains of the quadriceps, extension of the leg is desirable to avoid stretching of the muscle by flexion movements , in sprain of the biceps the forearm is flexed, and in strain of the tendo Achillis the principle is achieved by plantar flexion of the foot, as by the simple device of increasing the height of the heel of the shoe on the affected side

Rupture of Muscle or Tendon —If a muscle or tendon is completely ruptured, immediate suture is in most cases the wisest procedure and should lead to a more rapid restoration of function than is possible with conservative methods

ADHESIONS

By careful attention to the principle of avoidance of strain during repair of the damaged ligament, muscle, or tendon, combined with early active movements, it should usually be possible to avoid the bugbear of troublesome traumatic adhesions A certain degree of temporary stiffness often occurs, but this is normally slight and quickly disappears with use of the limb, combined, if necessary, with such measures as heat, massage, and special exercises When rest has been too prolonged, adhesions in or around muscles, ligaments, or tendons may resist these measures, and manipulation under anæsthesia is indicated Manipulation, often so eminently successful in suitable cases, should be adopted as soon as it is evident that the adhesions are not yielding to the usual methods of physical treatment

CHAPTER XXXIX

PLASTER-OF-PARIS TECHNIQUE

By F P Fitzgerald

Plaster of Paris bandages are made in 8 in 6 in , and 4 in widths and all are six yards in length They should weigh 17, 14 and 11 ounces respectively, and be kept in air tight tins Immediately before use the bandage is placed in water, and allowed to rest until bubbles cease to rise Then the *ends* of the bandage are gripped firmly and it is squeezed free of excess water (*Fig* 295) The

F g 295 —Squeezing a plas er bandage I s grasped by ts *ends*

F g 296 —Method of making a plaster slab

F g 297 —Method of folding a slab on tself

temperature of the water varies according to whether slow or quick setting is required Plaster sets more quickly with hot water the maximum temperature that can be used being 130° F Salt increases the rate of setting

Plaster bandages may be rolled on like ordinary bandages or applied in the form of slabs made by rolling a bandage up and down on itself to the required length (*Fig* 296) A narrow slab is made by folding one on itself (*Fig* 297) These slabs are fixed to the limb by a circularly applied open wove gauze bandage Where necessary, plaster bandages are applied over this

Rules for Application of a Plaster Bandage.—

1 Begin above and bandage downwards

2 Leave an inch between the tops of the turns so that the cast will be the same thickness throughout

3 Do not allow any creases next the skin

4 Do not twist the bandage or attempt to do 'figures of 8'

5 Remember that a plaster cast does not contract while setting (*See* PRESSURE SORES, p 281)

Padded or Unpadded?—Both padded and unpadded casts have their uses in actual practice

A *padded cast* is one in which the skin and plaster are separated by wool or stockinette or both

An *unpadded cast* is one in which the plaster slab and skin are in actual contact It is important that the latter definition should be qualified, for while it is true that plaster and skin *are* in contact, the *entire* limb surface is *not* so encased Bohler's 'unpadded cast' is undoubtedly the best form A plaster slab is applied, encasing two-thirds of the limb at its narrowest part (*Fig* 298) This is kept in position by a gauze bandage *six yards long and six inches wide*, in adults The latter is put on loosely and provides a layer of padding about a quarter of an inch thick over at least one-third of the limb's surface *A completely skin-tight plaster should never be applied*

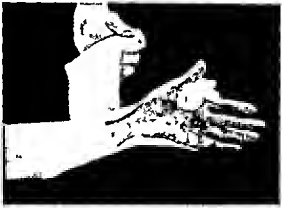


Fig 298 —Application of a dorsal slab Note (1) Pad of wool separating index finger and thumb, (2) Slab does not include volar third of wrist (3) Gauze bandage being used to fix slab

Instructions to the Patient—*A patient should not be allowed to leave hospital without written instructions about how to recognize obstruction to the circulation, and what to do if it should occur*

TYPE OF INSTRUCTION CARD

1 If the fingers or toes become painful, swollen, or blue, elevate the limb

2 If there is no improvement after half an hour, come back to hospital or call in a doctor

3 If it is impossible to obtain medical advice, remove the plaster with a knife or saw Soaking in water softens plaster

APPLICATION OF PLASTER IN SPECIAL REGIONS

THE HAND OR WRIST

Materials—

1 Two plaster bandages 6 yd by 6 or 4 in } depending on the size of the limb
2 A gauze bandage 6 yd by 6 or 4 in }
3 A 4 in band, for counter traction

Position of Patient—When traction is necessary the patient lies on a table with the humerus abducted to 90° and the elbow at a right angle The band is

passed round the arm above the elbow over a pad of wool, and fixed to some stable object such as a door-handle A layer of strapping wrapped round the thumb and the radial three fingers provides a good grip for the assistant An assistant then pulls on the fingers and thumb in the opposite direction (*Fig* 299)

Fig 299 —Application of cast for elbow or forearm injuries Note (1) Manual traction, (2) Fixed counter traction, (3) Spreader separating loop of traction band.

Technique —The distance from olecranon to knuckles is measured A plaster slab of this length is laid along the dorsum of the forearm, wrist, and hand, as far as the knuckles It is moulded to the limb A small pad of wool is then placed between the thumb and index finger and the cast is bandaged on evenly, but not tightly, with the gauze bandage, two turns of which hold the wool pad in place The second plaster bandage is now applied circularly and the cast allowed to set Any excess can then be trimmed

THE ELBOW AND FOREARM

Materials —
1 Four plaster bandages 6 yd by 6 or 4 in } depending on the size of the limb
2 One gauze bandage 6 yd by 6 or 4 in.
3 Band for counter traction, with wooden spreader
4 Small pad of wool

Technique —The position of the patient is as described for the wrist cast The limb is measured from the insertion of the deltoid to the knuckles A slab of this length is applied from the knuckles along the dorsum of the forearm, behind the elbow, and along the extensor surface of the arm The wooden spreader widens the loop of the counter-extension band to allow the slab to pass through (*Fig* 299) At the elbow, cuts are made into the slab at each side and the edges folded accurately over each other The wool is placed between the finger and thumb, and the slab is wrapped on by the gauze bandage Two circular plaster bandages are now applied and the cast is allowed to set The extension band is then removed from the arm and the final plaster bandage strengthens that region

THE UPPER ARM

Materials —
1 Three plaster bandages 6 yd by 6 or 4 in } depending on the size of the limb
2 One gauze bandage 6 yd by 6 or 4 in
3 A strip of felt 1 in wide
4 A cuff and collar sling

Technique —The strip of felt is fixed round the arm close to the axilla A 6-in slab is made long enough to extend from the acromion round the elbow to the axilla It is folded on itself to make a 3 in slab (*see Fig* 297) The slab

is then applied to the inner and outer surfaces of the arm in the form of a U (*Fig.* 300) It is moulded to the contour of the limb and fixed by the gauze bandage and the remaining two plaster bandages A cuff-and-collar sling is

Fig 300 —The U shaped slab is placed along the inner and outer aspects of the arm

Fig 301 —Shoulder spica. The cast should extend lower over the iliac crests

applied, with the elbow at right angles In fractures with much displacement it is advisable to increase the weight of the plaster by adding the elbow or forearm cast Transverse fractures of the middle third of the humerus may require an abduction splint or plaster spica (*Fig* 301)

THE SHOULDER SPICA

Materials —

1 Twelve plaster bandages, four 6 yd by 8 in, eight 6 yd by 6 in Or in a child four 6 yd by 6 in, eight 6 yd by 4 in
2 One gauze bandage 6 yd by 6 in
3 *Stockinette, wide and narrow*
4 Wool

Position of Patient —Sitting on a stool or standing, the arm is abducted to a right angle and is 30° in front of the coronal plane The elbow is flexed to a right angle and is in the mid-position between pronation and supination

Technique —A length of wide stockinette is taken long enough to reach from *neck to pubes A hole is cut on either side at the shoulder level to allow the* arms to be passed through as in a sleeveless vest

The narrower material is drawn over the arm like a sleeve from knuckles to shoulder Pads of wool, ¼-in thick when compressed, are placed along the iliac crests, over each shoulder, and along the spine, and are held in place by the gauze bandage

Two wide plaster bandages are now applied around the abdomen and thorax and across the shoulders Plaster slabs made from narrow bandages are applied from the axillæ to the iliac crests, where they are accurately moulded They are held in position by one wide bandage Then a wide bandage is applied as a shoulder spica A long slab is fixed to the extensor aspect of the arm, forearm,

and hand as far as the knuckles, with one gauze and three narrow circular bandages A narrow bandage is next made into a slab and folded on itself to act as a prop, which extends from the side of the cast in the axillary line to the under surface of the elbow, and is fixed to both cast and arm by the remaining bandage If the cast does not extend to the iliac crests it sags to one side, and may cause a pressure sore The edges are trimmed and the stockinette folded back at the margins of the cast Over the sternum the cast is cut in the form of a V

THE LEG

Materials —
1 A high chair table, or a traction apparatus
2 Five plaster bandages 6 yd by 6 or 4 in. } depending on the size of
3 One gauze bandage 6 yd by 6 or 4 in } the limb
4 A walking iron or Sorbo rubber

Position of Patient —If skeletal traction is being used, the leg is slung in the traction frame In other cases, the patient sits on a high chair or table, the operator sitting on a low stool with the patient's foot resting on his knee The sound leg is supported on a stool or chair

Fig 302 —The narrow slab is placed along the inner and outer aspects of the leg

Technique —A long slab is made and folded on itself so as to be 3 in instead of 6 in wide (*see Fig* 297) It is applied from the lateral condyle of the tibia along the outer side of the leg, then under the heel and along the inner aspect of the leg to the medial condyle (*Fig* 302) Another slab is made long enough to extend from the back of the knee, passing behind the heel, to beyond the toes It is applied along the calf and sole, and a transverse cut is made on either side at the heel The edges are folded over evenly These slabs are fixed to the limb by a gauze bandage The circular plaster bandages are then rolled on from above downwards The plaster is trimmed so that the dorsal surfaces of the toes are free A vertical cut an inch long over the upper end of the fibula prevents pressure over the peroneal nerve

Application of a Heel —

A plaster heel is simply a plaster bandage which is partially unwound and fixed just in front of the heel

A rubber heel is made from two pieces of ½-in Sorbo rubber as wide as the sole of the cast and one-third its length The pieces of rubber are bound together by a few turns of the plaster bandage and then fixed in position with the remainder of the bandage

An iron heel is applied *exactly* in the line of the leg, and not tilted backwards or forwards (*Fig* 303) It extends an inch and a half below the plaster A turn of a 6 in. bandage is taken round the anterior part of one cross-bar The bandage then passes behind the calf to the anterior part of the opposite cross bar, thus forming a posterior sling An anterior sling is formed by reversing this manœuvre The soft cross-bars are moulded firmly against the cast, and two turns of the bandage fix them The bandage is continued down the leg around

the iron shaft to the ankle The attenuated bandage is passed through the loop of the iron, and anterior and posterior slings are again formed, care being taken to ensure that the iron is still in the line of the leg The sole of the plaster can be kept clean by using a piece of old motor tubing a little longer than the foot, with a hole cut out to allow the plaster foot to enter (*Fig* 304)

Fig 303 —Application of an iron heel. The long axis of the heel must be in the line of the leg

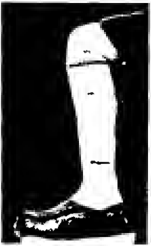


Fig 304 —The Stanmore galosh.

THE THIGH AND LEG

Materials —

1 Eight plaster bandages 6 yd by 6 or 4 in } depending on the size of the limb
2 Two gauze bandages 6 yd by 6 or 4 in }
3 Iron or Sorbo heel
4 Strip of ½-in adhesive felt 1 in wide

Technique —The strip of felt is placed round the limb at the upper limit of the thigh A gauze bandage is wrapped round the knee The limb is measured from the natal fold, round the heel to the toes A slab is made from two 6-in bandages and is applied along the thigh, calf, and sole to the toes It is cut at right angles at the heel on either side and the edges are moulded over carefully The slab is bound on by a gauze bandage and four circular plaster bandages A heel may be fixed as described above

THE SHORT HIP SPICA

Materials —

1 Ten plaster bandages 6 yd by 8 in, and four 6 yd by 6 in In a child, six 6 yd by 6 in, and four 6 yd by 4 in
2 Stockinette, wide and narrow
3 Gauze bandage 6 yd by 6 in
4 Wool
5 Pelvic rest or Hawley table

Preliminary Measures —A piece of wide stockinette is drawn over the head and shoulders and reaches from the groin to the nipples The narrower piece is drawn over the affected limb and reaches from groin to knee Pads of wool, ½ in thick when compressed, are placed over the anterior superior spines, the

iliac crests, the sacrum, and around the adductor region All the pads are fastened into position by the gauze bandage

Position of Patient—The patient is placed on the pelvic rest or Hawley table If a Hawley table is used, the feet are bandaged to the sole plates The knee is

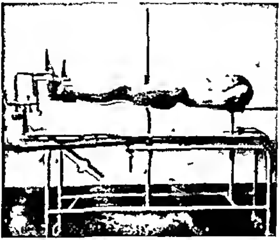


Fig 305—Position for application of hip spica The knees have not yet been suspended.

suspended by a bandage from the cross-bar to avoid extension of the hip and hyperextension of the knee The table is then 'let down', so that the patient is suspended by the shoulders, pelvis, and feet (Fig 305)

Fig 306—Short hip plaster Note the moulding over the ilium and greater trochanter On the left side it is cut away to allow the hip to flex to a right angle

Technique—Two wide plaster bandages are applied to the chest and abdomen and then as a spica over the pelvis and upper thigh Two slabs made from narrow bandages are applied, one along the lateral aspect and the other in front of the hip A wide bandage holds these in place, and then a slab is placed along the back of the thigh, from the back of the hip to the knee The remaining wide and narrow bandages are applied circularly above and below During the application of the cast it should be moulded deeply above and below the iliac crests and around the greater trochanter so that visible grooves are formed The cast is then cut out in the form of a V or half-moon over the upper abdomen, leaving it high at both sides The plaster is cut away at the upper border of the pubis, and on the sound side along the groin, to permit flexion of the thigh to a right angle (Fig 306) Then the patient is taken off the table, turned on to the face, and an area cut out behind to expose the upper limit of the natal cleft

THE LONG HIP SPICA

Materials —

1 Sixteen plaster bandages, six 6 yd by 8 in, ten 6 yd by 6 in Or in a child, six 6 yd by 6 in, ten 6 yd by 4 in
2 Two gauze bandages 6 yd by 6 in
3 Stockinette, wide and narrow
4 Wool
5 *Pelvic rest or Hawley table*

Technique —The position of the patient is the same as in a short spica (*see Fig* 305), and the same routine is followed as far as the knee Then a slab is made to extend from the mid-thigh to the lower third of the leg and covered with one gauze and two plaster bandages Another slab reaches from the middle of the calf to the tips of the toes, and is fastened with one gauze and one plaster bandage In an active child or heavy adult, the cast may need extra strength This can be achieved by making a slab from a 6-in bandage, folded on itself to make a 2-in plaster rope, and incorporating it along the lateral aspect of the thigh from above the hip to below the knee The cutting out and moulding are as before On the plantar aspect the plaster is cut flush with the tips of the toes, on the dorsum it is trimmed along the line of the web

THE DOUBLE HIP SPICA IN 'FROG' POSITION

Indication —For a reduced congenital dislocation of the hip

Fig 307 —A simple pelvic rest The child is laid upon the board wool and plaster are applied after which the board is extracted

Fig 308 —Double hip spica plaster Note wide area cut out to prevent soiling

Materials —

1 Twelve plaster bandages, six 6 yd by 6 in, six 6 yd by 4 in
2 Stockinette
3 One gauze bandage 6 yd by 6 in
4 Wool
5 Stille s or other small pelvic rest (*Fig* 307)

Position of Patient —The child lies on the pelvic rest with thighs widely abducted, and both hips and knees flexed to right angles

Technique —The stockinette is drawn over the body and limbs, and a layer of wool is rolled on to cover the abdomen and both limbs to the ankles Two wide plaster bandages are applied around the abdomen and pelvis as a double spica bandage Slabs are placed on either side from the upper edges of the cast to the middle of the leg, and are fixed by two wide circular bandages, Finally three small circular bandages are applied on each limb as far as the ends of the slabs A large area is cut out extending an inch above the pubis, an inch above the top of the natal cleft, and three inches from the midline on either side (*Fig* 308)

THE PLASTER JACKET

Materials —

1 Ten plaster bandages, six 6 yd by 8 in, four 6 yd. by 6 in Or for a child, six 6 yd by 6 in, four 6 yd by 4 in
2 Stockinette
3 Gauze bandage
4 Wool

A stockinette vest as in a shoulder spica is worn, if the neck is to be included, the vest should be allowed to extend above the head during the application of the cast, and have spaces cut out for the eyes and mouth Wool pads, ½ in thick when compressed, are placed over the iliac crests and the shoulders, and along the spine and sacrum In a cervical case a layer is wound around the neck These pads are retained in position by the gauze bandage

Fig 309 —The patient holds the sides of the frame to steady himself The feet are fixed and traction is maintained by overhead cord and pulley

Position of Patient —This varies according to the lesion If a fracture of the dorsal or lumbar vertebræ is being treated, the cast is applied in a position of extension, the weight being taken by a band round the chest and attached to a block and tackle, or between two tables (*see Fig* 352) For a case of cervical caries the child is placed in a special frame (*Fig* 309) Shoes are strapped to the feet, and these are in turn screwed to the floor boards of the frame A sling is attached under the chin and occiput, and most of the body-weight is taken by a cord over a pulley on the overhead cross bar

Technique —

Thoracic or lumbar case Two wide plaster bandages are wrapped around the chest and abdomen, extending to the sternal notch above and the pubis below

Four slabs made from narrow bandages are now applied. One on each side extends from the axilla to three inches below the iliac crest, another from the sternal notch to the front of pubis, and the fourth along the spine posteriorly to the upper limit of the natal cleft These are fixed by two more wide bandages and then circular slabs made from narrow bandages are applied around the upper and lower margins of the cast Two wide plaster bandages complete the cast (*see Fig* 353) An area the size of a dinner plate may be removed over the upper abdomen At the groin the plaster is cut on either side to allow flexion of the thighs *to a right angle* *It is essential that these casts be moulded accurately* over the iliac crests, the lumbar lordosis, the pubis, and the sternum

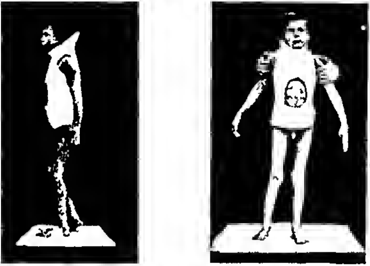


Fig 310—Finished plaster jacket for case of cervical caries

Cervical case The routine is the same, except that alternate turns of the circular bandages are taken over the shoulders Two circular bandages are then wound round the neck and shoulders, including the chin, skirting the lower borders of the ears, and extending up on to the occiput posteriorly A slab is applied from the occiput to the upper part of the thorax, and flexed by two wide circular bandages The plaster is cut along a line running parallel to, and half an inch *above*, the lower border of the mandible, just below the ears, and along the line of the occipital bone The stockinette is then folded back and fixed with a narrow plaster bandage (*Fig* 310)

PLASTER BEDS AND ANTERIOR SHELLS

Materials—

1 Plaster muslin. Twelve doubled sheets of this are cut beforehand For an anterior shell the patient is measured from the nasion to the ankle, for a bed, from the nasion *over the vertex* to the middle of the calf In both cases the width is the distance between the tips of the elbows when the arms are abducted to right angles
2 Plaster-of Paris, 14 lb
3 A basin holding 12 pints of water at 130 F, and a spoon for mixing
4 Vaseline, a bathing cap, and wool
5 *A table covered by a rubber mattress*
6 An adjustable stool and sandbags
7 Scalpels and linoleum knives

Position of Patient—For a plaster bed the patient lies prone, with the chin resting on the edge of the table, arms abducted to 45°, and each leg abducted to 15° (*Fig* 311) For an anterior shell, the patient lies on his back with legs and arms arranged similarly, the neck is allowed to hyperextend over the edge of the table until the under surface of the chin is horizontal (*Fig* 312) The head is supported in position by a sandbag resting on the stool, and the face is covered with a sheet of gauze The bathing cap covers the hair completely In the plaster bed, pads of wool are placed over the ears to make the finished cast more roomy A very thin layer of vaseline is smeared over the skin and the minimum of wool used to cover the pubic and perineal regions

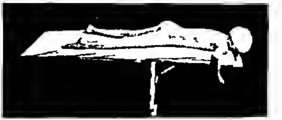


Fig 311 —Position for plaster bed. The chin is supported on the edge of the rubber mattress leaving an airway above the table top

Technique—

The assistants A team of five is the ideal, but the number may be reduced to three The first assistant makes the plaster cream by adding the plaster to the water, and stirs the mixture to an even consistency The second assistant hands the double sheets by their folded ends to the first, who dips them thus into the cream The sheets, now like ropes, are lightly stripped of excess cream and are handed quickly to the other assistants, who are placed as follows the third stands at the head of the patient, the fourth and fifth on either side near the knees

Applying the sheets The third, fourth, and fifth assistants open out the sheet, pull it taut to remove all creases (*Fig* 312), let it fall squarely on to the patient, and then smooth away air-bubbles from the midline outwards The fourth and fifth assistants, as each sheet is laid, press it down firmly to the table between the thighs and perineum so as to form a flat bridge connecting the gutters for the legs The excess muslin—except in the first and last sheets, which determine the internal and external finish of the cast—is folded back at the level of the knees on to the thighs At the sides the sheets are not moulded under the patient, to avoid

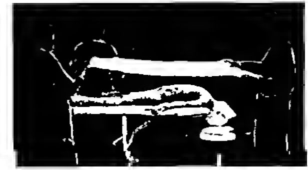


Fig 312 —Position for anterior shell applying the first sheet. Note the hyperextension of the neck so that the chin is horizontal.

difficulty in removing the cast The sides may be strengthened by folding back the excess of every second sheet

Including the head. If a bed is being made with a head-piece, that is, in lesions above the sixth dorsal vertebra, the third assistant, standing at the head, folds back the excess of the ten intermediate sheets at the vertex and in front of the ears, moulding it to the back and sides of the neck. In the case of an anterior shell, the intermediate layers are folded back along the symphysis and body of the mandible, to form a strong horizontal chin-piece

Speed is essential, as the warm plaster cream sets rapidly, if setting is delayed half an ounce of salt should be added to the cream The procession of sheets *must follow without break, and all must be laid within five minutes* The cast is allowed to set until it gives a high-pitched note when tapped

Outlining While waiting, the outlines are marked with a sharp scalpel—the sides an inch from the table level, the shoulders in line with the sides, and the upper and lower edges at the level of the folding back. An area for nursing purposes is outlined It extends in a bed from the top of the natal cleft, or in a shell from an inch above the pubic crest, to midway between the perineum and knee, exposing the medial third of each thigh In a bed, care is taken to make the opening a pointed arch so that the buttocks are supported adequately When *the cast has set, it is lifted off* and laid on another table, where the outlines already marked are quickly cut through with the linoleum knives It is then tried on and trimmed if necessary The whole proceedings should not take longer than fifteen minutes The cast is dried for two days in a heated room

Mounting The cast is now mounted on three shaped transverse supports of 1-in timber, high enough to allow a bed-pan to be inserted easily These uprights are fixed by countersunk screws at the neck, lumbar region, and above the knee, and joined by two horizontal strips of three-ply wood (*Fig* 313) A loose lining is made of linen sheeting and thin blanket sewn together along the edges, having a piece cut out corresponding to the nursing area of the plaster cast It is held in position by tapes which tie underneath the cast

Fig 313 —Mounted plaster bed Three wooden uprights connected by three-ply struts allow ease of nursing, and protect the plaster The holes in the headpiece are for ventilation

FINISHING PLASTERS

A good finish to a plaster may be obtained by rubbing the setting plaster smooth with clean moist hands This may be improved upon by rubbing the surface over with a wet plaster bandage If stockinette is used, it is folded back over the trimmed plaster edges, and fixed by a narrow bandage

REMOVING PLASTERS

Nowadays this is not a very difficult procedure, as casts are thinner than formerly The instruments used are Stille's shears, Bohler's scissors, and Lloyd's opener (*Figs* 314, 315) The last is a very useful instrument when a plaster has been cut through and the two edges have to be pulled apart

A few points need to be stressed Never cut over a bone In a leg plaster cut down vertically between tibia and fibula along the anterolateral aspect Cut where the plaster is thinnest. It is strange how many people cut along the dorsum where the slab has been applied, instead of along the thin volar aspect In difficult cases or in frightened children the cast can be softened by soaking it in warm water In a plaster which

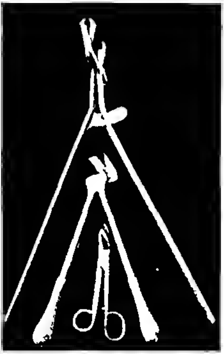


Fig 314.—Plaster instruments Lloyd's opener Stille's shears Bohler's scissors

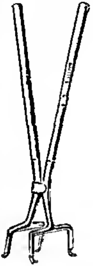


Fig 315 —Lloyd's plaster opener

has to be split immediately after application, include a copper strip next to the skin (Lloyd) and cut down on it before the plaster has set The line of the strip is followed by allowing it to protrude above and below the edges of the cast When the plaster has been split, the strip is removed by pulling it through

CHAPTER XL

EMERGENCY TREATMENT OF FRACTURES

By R WATSON-JONES

In the treatment of any fracture the condition of all the deep tissues of the limb must be visualized *Careless handling not only causes unnecessary suffering* and shock, but may endanger adjacent vessels or nerves, and by tearing the overlying skin may convert a closed into an open fracture

The immediate emergency treatment of fractures includes (1) First-aid splinting, (2) Precautions in transport, (3) Temporary splinting, (4) Treatment of shock

FIRST-AID EMERGENCY SPLINTING

"Splint them where they lie" Before the patient is moved from the site of accident, suspected *fractures* must be *immobilized* by *splints* constructed of strips of wood, walking-sticks, or even folded newspapers The splints must extend beyond the joints above and below the level of injury, and as a rule the whole limb should be immobilized In the case of thigh injuries, first-aid splints of this type must obviously extend over the trunk as well as over the whole lower limb, and added fixation may be secured by tying the two lower limbs together

If a Thomas's splint is available it is the best emergency splint for lower limb injuries It is applied before the boot or trousers are removed, and before the wound is dressed Traction is applied to the limb, so that it can be raised without angulating the fragments, and while traction is maintained, the ring of the splint is guided over the foot, leg, and thigh, and pressed firmly against the pelvis The foot may be fixed to the notch at the lower end of the splint by means of a clove-hitch bandage round the ankle, but this method is dangerous because the pressure of the bandage may cause sloughing of the skin or even gangrene of the foot It is better to use a metal skewer through the instep of the boot just above the sole, or a metal clip known as a Picton or Millbank clip (*Fig* 316) which is sprung on to the margin of the sole The skewer or spring clip is fastened to the end of the splint with strong cord Immobilization is completed by bandages encircling the limb and splint

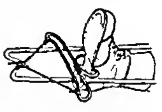


Fig 316.—The Millbank clip

METHODS OF TRANSPORT

The ways in which two first-aiders may clasp hands to provide a seat for the helpless patient, is part of the *knowledge of every Boy Scout* In lower limb and trunk injuries an attempt should be made to improvise a stretcher from deck chairs, doors, or short ladders

If a patient is quite helpless and has to be lifted on to a stretcher or carried any distance, two assistants should co-operate with the surgeon, who steadies and controls

the injured limb The assistants take up a position on opposite sides of the patient facing each other, they then stoop down and each gradually inserts one hand under the patient s chest until they meet and are clasped, the other hands are then passed and locked under the pelvis Having secured a firm grasp they rise together from the stooping position and are ready to move They should not march in step, rhythmic swaying is avoided if the left foot of one is put forward with the right foot of the other

Transport in Suspected Spinal Fractures—Patients with suspected fractures of the spine must be moved with particular caution, because damage to the spinal cord may cause permanent paralysis If a patient with a fractured spine is lifted face upwards by the shoulders and hips, sagging of the trunk between the two points of support forces the injured area into flexion The spine above and below the fracture forms such a powerful pair of levers that this apparently simple movement may crush the spinal cord On the other hand, the man may be lifted by the shoulders and hips face downwards and no harm is done because the spine sags into the relatively safe position of extension (*Fig* 317) As soon as possible, the patient is placed on a stretcher, and not moved from it until radiographic examination in hospital is completed

Fig 317—Face-down transportation. The spine is extended displacement of a fractured vertebra is reduced, and the cord is safe from injury

It is actually much easier to carry a helpless victim face downwards than face upwards, for many generations the Swahili negroes of Africa have carried their victims of accident this way Even when the patient is on a stretcher or lying in bed, he is usually more comfortable in the prone position with pillows beneath the upper chest and head than in the usual face up position.

If the injury is in the cervical spine the surgeon himself must hold the head and maintain constant traction, keeping the neck in the fully extended position, and not allowing any single flexion movement

TEMPORARY SPLINTING

The patient having been placed on the bed, first aid splints may be removed for more adequate examination The clothing should be removed by cutting off boots and by ripping up the seams of clothes Throughout this procedure the injured limb must be steadied by applying firm traction A thorough general examination of the head, chest, spine, abdomen, pelvis, and all limbs is essential in every case of accident The surgeon must not allow his attention to be so concentrated on one obvious injury that he overlooks others less conspicuous

It may be necessary to use temporary splinting before formal reduction and immobilization of the fracture is undertaken

Fractures of the Clavicle and Shoulder.—A small pad of wool in the axilla and a triangular sling tied over the opposite shoulder elevating the injured limb is a sufficient temporary support.

Fractures of the Humerus.—The wrist should be suspended from the neck by a collar and cuff sling by passing an ordinary bandage through two sleeves of basil leather or of folded brown paper The fragments of the humerus are immobilized by three or four short padded gutter splints extending from just below the shoulder to the level of the elbow-joint (*Fig* 318) The possibility of injury to the musculospiral nerve must be borne in mind

Fig 318 —Temporary splinting of fractured shaft of humerus by gutter splints and collar and-cuff

Fractures of the Elbow.—The wrist is slung from the neck by a collar and cuff The elbow must not be forced into full flexion, but should be held in a comfortable position above the right angle When there is very severe swelling round the joint, a simple triangular sling may be used with the elbow at or just below the right angle The limb must be examined for possible injury to the ulnar, median, or musculospiral nerves, and the circulation tested frequently by noting the colour of the fingers and by feeling the radial pulse Severe elbow injuries are often complicated by damage to the vessels and nerves Prompt reduction of bone displacement and continued supervision during the first few days are of great importance

Fractures of the Forearm—The forearm may be immobilized by an anterior angular splint extending from the middle of the upper arm across the front of the elbow to the wrist-joint, together with a simple gutter splint on the back of the forearm from the elbow to the knuckles (*Fig* 319) The anterior splint must not

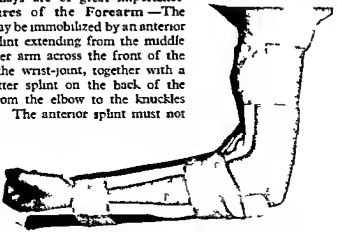


Fig 319 —Temporary splinting of fractures of the forearm bones.

extend beyond the skin creases of the wrist If it reaches into the palm of the hand, undue pressure on the thenar eminence causes wasting of the muscles,

and the limitation of flexion of the fingers causes stiffness of the joints Care must be taken that the angle of the splint does not press too firmly on the front of the elbow joint The circulation and movement of the fingers demand constant attention during the first few days If cyanosis or pallor develops, or if there is the slightest difficulty in extending the fingers fully, the splints must be loosened at once (*See* VOLKMANN'S CONTRACTURE, p 280)

Fractures of the Wrist—Two padded metal gutter splints are used, one extending from just below the elbow down the back of the forearm to the knuckles, and the other a short splint from below the elbow to the level of the wrist joint The anterior splint falls short of the thenar eminence and should not extend into the palm (*Fig* 320) The splints may be slightly twisted, to maintain pronation

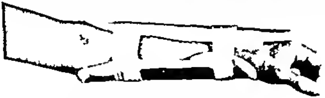


Fig 320—Two gutter splints and wool pads for Colles's fracture of radius

of the forearm and ulnar deviation of the hand Two pads of wool are used to preserve the normal forward curve of the lower end of the radius One pad over the front of the lower forearm two or three inches above the wrist level occupies the radial concavity, and a second pad is placed over the back of the lower radius immediately above the wrist joint. The finger joints must be left free for movement If there is œdema of the fingers and hand, the limb must be well elevated until the swelling has subsided

Carr's splint, an anterior wooden splint with a bar of wood occupying the lm of the hand, should no longer be used even for temporary splinting of the ist, because it so frequently causes stiffness of the fingers

Fractures of the Spine—The patient must be kept recumbent with the ine in the fully extended position Fracture boards are essential These e ordinary 1 in thick planks of wood about six inches across and slightly longer an the width of the bed, laid across the frame beneath the mattress to keep it m and prevent sagging

If the patient is lying face upwards, arching of the spine is maintained by o firm pillows beneath the dorso lumbar junction As a rule these patients e more comfortable in the prone position The pillows must then be arranged neath the upper thighs and beneath the upper part of the chest, so that the spine still fully extended

If the injury is in the cervical region there must be no pillow behind the head A firm pillow is arranged behind the shoulders so that the neck is extended, and the head is kept at rest by sandbags on each side Forward movement of the head is prevented by means of a small towel crossing the forehead and anchored by the sandbags

In all spinal fractures injury to the spinal cord must be excluded by noting the power, sensation and reflexes of the lower limbs, and the functions of the bladder and rectum

Fractures and Dislocations of the Pelvis—The patient should be in lateral recumbency lying on the uninjured side on a firm mattress over a

TREATMENT OF SHOCK

Every patient who has sustained a fracture or dislocation suffers from some degree of shock and collapse If shock is severe the patient must be put in a warm bed in a well-heated ward, given morphine to control pain, and copious draughts of water or sweetened tea or coffee If the pulse-rate is rising or the blood-pressure is falling, the transfusion of 2 or sometimes even 3 pints of blood, blood-plasma, or blood serum, is urgently necessary During the first few hours, the treatment of shock far outweighs in importance the local treatment of the injury

Local Anæsthesia of Fractures—The only local treatment which is safe, because it may be undertaken without movement of the limb or disturbance of the patient, is the administration of a local anæsthetic The relief of pain and the blocking of all afferent nerve impulses from the fracture is of value, especially in fractures of the shaft of the femur and tibia, and in fracture-dislocations of the ankle and knee An injection of from 10 to 20 c c of 2 per cent novocain is made into the fracture hæmatoma A long needle is used, and the surgeon should confirm that the needle is actually in the hæmatoma by withdrawing one or two cubic centimetres of blood before actually injecting the novocain

Compound Fractures—In the case of compound fractures, hæmorrhage must be controlled and the wound covered with sterile towels No local anæsthetic may be injected into the open wound because there is a danger of disseminating infection Operative treatment of the wound is of particular urgency, and must not be deferred one hour more than is absolutely essential for the treatment of the shock

CHAPTER XLI

GENERAL PRINCIPLES IN THE TREATMENT OF FRACTURES

By R Watson Jones

There are three principles of fracture treatment, all of equal importance, which must be in the mind of the surgeon from the first day of injury until the last day of recovery —

1 *Reduction* —To correct displacement perfectly and maintain replacement of the fragments, always using X ray control

2 *Immobilization* —To fix the fragments completely and without interruption until the fracture is firmly united

3 *Functional Activity* —To preserve movement in joints which need not be immobilized, by the patient's own active exercise, but never by passive stretching To maintain the tone of muscles even in the parts immobilized, and to encourage use of the limb, as far as possible, throughout the period of immobility

REDUCTION OF DISPLACEMENT

Manipulative Reduction —The 'setting' of fractures is not a special art dependent on hereditary skill The technique consists simply in inspecting radiographs to see where the fragments lie, replacing them by direct pressure or by traction, X-raying to see that the object has been achieved, and repeating the routine "manipulate, fix, X ray" as often as may be necessary Occasionally manipulative reduction may fail owing to anatomical difficulties or to undue delay in instituting treatment, and operative reduction is necessary

Reduction must be effected by guarded measured strength rather than by sudden jerking force This is important in fractures of the shafts of the long bones where considerable leverage is possible, it is particularly important in greenstick injuries, which must be reduced by gentle moulding, taking care not to convert the injury into a more difficult complete fracture In fractures near the ends of the long bones, especially when impacted, much more force may be necessary Frequently in fractures of the ankle, and sometimes in other fractures, the radiograph will show that the fragments lock when fully reduced, so that over-reduction is impossible

Manipulation under Anæsthesia —No displaced fracture should be manipulated without an anæsthetic, to do so is unfair to the patient and unfair to the surgeon The patient may permit one sudden movement which he does not fully expect, but he will certainly not allow any further manipulation, and no fracture can always be perfectly reduced by one sudden movement Even old and fragile patients can withstand two or three minutes of gas anæsthesia with safety

In the very rare cases where general anæsthesia is inadvisable owing to constitutional disabilities, local novocain anæsthesia may be used (*see* p 272) Ten minutes should elapse after injecting the novocain into the fracture hæmatoma to allow complete diffusion of the anæsthetic before the fracture is manipulated

Most surgeons prefer not to use local anæsthetics as a routine in all cases. Anæsthesia is not always perfect, and there is particular difficulty in impacted fractures where diffusion of the anæsthetic is difficult.

Standard of Reduction.—How perfectly must the fragments be replaced? Is an anatomical 'hair line' reduction necessary? The standard of end-result must be a limb clinically indistinguishable from normal—one which has normal function and which looks normal. The alinement must always be perfect, and there must be no rotational displacement. Slight lateral displacement may be of no significance in fractures of the shafts of the humerus and of the femur, but if lateral displacement exceeds a certain minimum, the bony thickening impairs the cosmetic result, particularly in subcutaneous bones such as the tibia. Furthermore, with marked lateral displacement the reduction may be unstable. X-ray examination is therefore essential after every manipulation, and the surgeon must be satisfied that the position, though not necessarily anatomically perfect, is compatible with perfect function and appearance.

Ideal Time for Reduction.—The fracture which is seen within about half an hour of the injury should be reduced under anæsthesia and immobilized at once. If it is feared that subsequent swelling may be of such severity that a complete encircling plaster cast would be dangerous, a plaster slab may be applied over half to two-thirds of the circumference of the limb and held in place by a bandage which can be cut at once if required. The encircling cast is completed the following day.

If the fracture is reduced and the plaster applied when the limb is already severely swollen, redisplacement very often occurs a few days later as the swelling subsides and the plaster becomes loose. In this event it may be better not to anæsthetize the patient unnecessarily, but without preliminary manipulation to immobilize the fracture by a plaster slab and put the patient to bed with the limb elevated. Two or three days later the swelling will have subsided and the fracture is then manipulated under anæsthesia and completely immobilized.

This routine of delayed reduction should not be applied to dislocations, nor to any fractures where the displaced fragments may exert pressure on nerves or vessels. Badly displaced supracondylar fractures of the elbow should be reduced at whatever stage they are seen, and whatever the degree of swelling.

Subsequent Check Radiographs.—If a fracture has been reduced and plaster applied over a swollen limb, a check radiograph is essential seven to ten days later before the new plaster is applied, in order to be sure that the fragments have not become redisplaced. Every time that splints are adjusted or plaster reapplied, a further radiograph must be taken through the new plaster, however unlikely it may appear that the position has been altered; slight but important changes in the position of the fragments commonly occur during the reapplication of plaster.

Certain fractures, particularly fractures of the lower shaft of the radius with radio-ulnar dislocation, fractures of both bones of the forearm, and fractures of the shaft of the tibia, are prone to redisplacement even despite a satisfactory initial reduction and closely fitting plaster casts. These fractures must be X-rayed again every second or third week, whether the plaster has been changed or not.

It has been said of fracture treatment that "bones are filled not with red marrow but with black ingratitude." This is no longer true if treatment is controlled, but if a surgeon fails to exercise detailed control of every stage of treatment, black ingratitude is his just reward.

Danger of X-ray Screening—Manipulation of fractures under the direct visual control of X-ray screening is dangerous to patients and very dangerous to surgeons and their staffs One surgeon within twelve months of adopting this technique, suffered X-ray dermatitis of the hands, warty pigmentation and ulceration of the skin, replacement of his nails by rough, irregular, broken talons, and amputation of one finger Another victim, after longer exposure, lost all eight fingers and one thumb, together with most of his nose and lips, owing to X-ray cancer

Repeated manipulations under one continuous anæsthetic can be controlled no less effectively by taking a series of ordinary radiographs, and using modern methods of rapid development and fixing of films, the surgeon and his staff protecting themselves from scattered rays during the exposures Each pair of films should be ready for inspection within three or four minutes

IMMOBILIZATION OF FRAGMENTS

The repair of fractures takes place by the development of a delicate cellular granulation tissue between the fragments which calcifies to form callus Tearing of this granulation tissue delays repair, the slightest shearing or rotation strain interrupts the continuity of the growing tissue and causes continued decalcification of the fragments

If movement continues, a fibrous gap develops and the final process of recalcification occurs, not in a continuous callus between the fragments, but across the bone ends, which become densely sclerosed so that non union is established Operative treatment by drilling or bone-grafting is then necessary in order to break up the sclerosis, before immobilization will succeed in promoting union

The more complete the immobilization the more rapid is the union Plaster casts are therefore preferable to splints, and the casts must be carefully moulded to the contour of the limb There must be no bulky wadding or thick layers of wool beneath the plaster, as a rule it may be applied directly to the skin or over a single or double layer of stockinette *Complete and absolute immobilization must be continued until the fracture is united, and even if the average period has been exceeded there must still be no interruption of the immobilization* Many factors account for slow repair and delayed union, they do not cause non union if the immobilization is suitably prolonged, but if immobilization ceases non union becomes established

Fractures unite more slowly in adults than in children A fracture of the shaft of one of the forearm bones is usually united in six weeks in a child but not until ten weeks in the adult

Union is delayed by infection, even a trace of infection may add several weeks to the duration of repair, and if there is severe infection, union may occur only after six twelve or eighteen months If the blood supply of one fragment is cut off by the fracture, all the repair must take place from the other fragment and union may not be complete until twelve to eighteen months after the injury There are other unknown factors which account for very marked variation in the rate of repair in apparently identical fractures

The accepted periods of immobilization must therefore be recognized as minimal periods, to be exceeded in any case where clinical and radiographic tests show a slower rate of repair Most fractures are united in children in two months and in adults in three months Fractures of the lower limb weight-bearing bones must be immobilized for the whole of this time, in the upper limb a shorter period of protection is necessary, particularly if the fracture lies near the joints so that leverage strains are reduced

MINIMAL PERIODS OF IMMOBILIZATION OF FRACTURES AND DISLOCATIONS IN ADULTS

Upper limb dislocations —	
Shoulder, elbow, carpal semilunar, finger joints	2 to 3 weeks
Upper limb fractures—near joints —	
Colles's, supracondylar, neck of humerus	4 to 5 weeks
Exceptions —Clavicle, 3 weeks, carpal scaphoid, 8 to 10 weeks	
Upper limb fractures—shafts of long bones —	
Humerus, radius, ulna	6 to 10 weeks
Lower limb dislocations and fractures of weight bearing bones —	
Os calcis, fracture dislocation of ankle, shaft and tuberosities of tibia, shaft and condyles of femur	10 weeks
Exception —Neck of femur, 4 to 12 months	
Spine—crush fractures and fracture-dislocations	4 to 6 months

FUNCTIONAL ACTIVITY

No joint must be unnecessarily immobilized Complete fixation of the fracture is essential, so that immobilization of the joints immediately above and below the injury cannot be avoided but no other joint must be covered by splints, plaster, strapping, or bandage *It is not enough that these joints are left free, it is the surgeon's duty to see that they are actively mobilized by the patient's own exercise*

Stiffness of the Fingers —Recovery should be complete after a Colles's fracture of the radius within about two months of the injury If the finger joints have been allowed to stiffen, it will be at least twelve months before the patient can use the hand, and the limb may even be permanently crippled This stiffness may develop within a few days, especially if the fingers are swollen and œdematous

Fig 323 —Full finger exercises must be practised although the fractured wrist is immobilized in plaster

The patient believes that swelling indicates a very severe injury, and that aggravation is to be avoided by guarding against the slightest movement of any part of the limb Exactly the opposite treatment is very urgently indicated *the more swollen the fingers the more imperative is active exercise* The patient must flex the interphalangeal joints by bending the fingers tightly into the palm, flex the metacarpo-phalangeal joints by reaching towards the front of the wrist with the finger tips, extend all the joints until the fingers are fully spread, and repeat the exercises for at lease five minutes every hour of the day (*Fig* 323)

In every upper limb injury the first step when the patient recovers from the anæsthetic is to teach him finger exercises He must be seen daily until movements are perfect, and any patient who through anxiety or lethargy fails to regain movement rapidly must be referred to a massage department—not for massage, but for daily supervision of the exercises If the swelling of the fingers is so severe that movement is difficult, the patient must be admitted to hospital, the limb elevated, and exercises supervised every hour

Finger exercises are equally important in fractures of the hand, wrist, or forearm in plaster, fractures of the elbow or shoulder in a collar and cuff sling, fractures of the humerus in a frame, or fractures of the clavicle in bandage or strapping Many healthy men have been permanently incapacitated from work by a simple fracture of the clavicle treated by *Sayre's* strapping which had bound the fingers and hand flat on the chest wall for only two or three weeks

Fig 324—Exercises fo the shoulder whilst the limb is encased in plaster

The Danger of Passive Movement—It is of vital importance that the exercise should be done by the patient himself, and that there should be no stretching or passive movement of any type

Passive stretching not only causes unnecessary pain, but it has exactly the opposite effect to that which is intended The stretching injures the joints, tears the capsule, increases the exudation and aggravates the adhesion formation *If stiffness of the fingers is threatening, the one way to make certain that the stiffness will be serious or even permanent is to force the joints*

Stiffness of the Shoulder—In fractures of the hand, wrist, and forearm, shoulder exercises are also important Several times a day the shoulder must be fully externally rotated, fully abducted, and internally rotated, by lifting the arm with its plaster until the hand is behind the neck, over the opposite ear, and in the small of the back (*Fig* 324)

Functional Use of the Upper Limb—As a rule no sling should be worn after the first day or two In many cases the patient may use the limb for dressing,

eating, and for light household duties This activity prevents stiffness of the fingers, and it maintains the tone of the muscles within the plaster, promotes a normal circulation, and minimizes adhesion formation round the immobilized joints so that subsequent recovery is more rapid (*Fig* 325)

Wasting of the Quadriceps—In lower limb injuries the thigh muscles

Fig 325—The range of wrist movement possible immediately the plaster is removed after six months immobilization for a fracture of the scaphoid. Functional activity and finger exercises have prevented adhesion formation round the joint despite immobility

rapidly waste, especially when the knee-joint itself is injured This wasting occurs so quickly that many months of treatment may be required to regain the losses of only two or three weeks No injured knee-joint should be immobilized without at the same time teaching the patient 'quadriceps drill' Smooth rhythmic contraction and relaxation of the muscle is continued for five or ten minutes every hour of the day

Rigid Clawing of the Toes.—Toe exercises are no less important when the foot and leg are immobilized in plaster, than finger exercises in upper-limb plasters The toes must not be immobilized in the clawed position, or rigid clawing of the toes and rigid transverse flat-foot will cause persistent disability The plaster must be moulded under the transverse arch, and if a platform of plaster is left under the toes, it must be bent down sufficiently to allow the metatarso-phalangeal joints to be flexed.

Functional Use of the Lower Limb.—In many fractures and dislocations of the foot and ankle, patients may safely walk with the limb immobilized in closely fitting plaster casts With certain fractures weight-bearing may begin within two or three days, but as a rule, especially when there was marked swelling of the foot at the time that the original plaster was applied, weight-bearing is deferred for two or three weeks until the new plaster has been applied The exercise maintains the tone of the leg muscles, it minimizes disuse decalcification of the bones, and it prevents circulatory stasis with resulting œdema and adhesion formation Even after union of the fracture, the patient who has a swollen, heavy, œdematous foot with decalcified bones and a painful stiff ankle cannot undertake the walking exercise necessary to overcome these disuse changes In such cases, if the foot is immobilized in plaster, so that the patient can walk several miles a day, the range of ankle movement increases steadily despite the immobility of the joint

Prevention of Disuse Œdema.—After prolonged recumbency there is always a tendency to swelling of the foot and leg when the upright position is resumed This is particularly marked if the limb has been in plaster so that the

circulation has become accustomed to a rigid external support When the support is suddenly lost, severe œdema develops during the daytime, and if left uncontrolled it may continue for many months Massage treatment is quite ineffective in controlling it As soon as the plaster is taken off, a semi-rigid or elastic dressing must be applied *There must be no interval between removal of the plaster and the application of elastic support* If, in error, an interval has been allowed, so that the leg is already swollen, the patient must be put to bed for two or three days with the foot elevated before the dressing is applied

Ordinary crêpe bandages may be used to control this swelling, but they tend to slip, and if the patient applies the upper turns of the bandage more tightly than the lower turns, the œdema is aggravated An elastic stocking, though useful, is expensive, and elastic strapping may irritate the skin and cause dermatitis Unna's zinc gelatine paste is non irritant and relatively cheap The cubes of gelatine are placed in a pot surrounded by water which is boiled until the gelatine melts to form a smooth paste The paste is painted on to the leg with a wide brush, and covered with a soft bandage spirally applied Two or three layers of alternate paste and bandage complete the dressing (*Fig* 326) It *must extend from the web of the toes to just below the knee*

Fig 326—Application of Unna's paste to prevent recurrent œdema after removal of plaster

Proprietary bandages are now available already impregnated with zinc gelatine paste (Viscopaste, Icthopaste, etc) The bandages are applied directly to the limb, but Icthopaste bandages must first be softened by immersion in hot water The dressing is retained until the muscle tone and circulation of the leg is restored, the patient's report that the dressing is no tighter at the end of the day than it was at the beginning shows that the tendency to œdema has subsided In the adult, protection is necessary for at least five weeks, and sometimes for several months

No plaster, strapping, or firm bandage should ever be applied to the thigh, knee, or upper leg with the lower leg and ankle left unsupported, œdema of the unprotected lower leg is inevitable If a plaster spica for the hip ends at the level of the lower calf, it must be extended to the toes by a Viscopaste bandage If a knee-joint which is tending to swell is firmly bandaged or strapped, the bandage must extend over the calf, leg, and ankle to the foot

CHAPTER XLII

COMPLICATIONS OF FRACTURES, AND COMPOUND INJURIES

By R. WATSON-JONES

EVERY patient with a fracture or dislocation must be examined at least once daily for several days after the injury, to confirm that (1) reduction is complete, (2) there is no undue friction at the margins of the plaster, (3) bandages or strappings are not too tight, (4) the circulation is normal, (5) there is no undue œdema of the fingers or toes, (6) the patient is practising exercises adequately

If the patient has not been admitted to hospital, explicit instructions must be given that he is to report the following day, and *if there is pallor, cyanosis, numbness, tingling, or immobility of the fingers or toes, he is to return at once whatever the hour of the day or night* When the danger of complications is over, the patient is examined once weekly until recovery is complete

LOCAL COMPLICATIONS

Œdema—During the first two or three days after injuries of the wrist and ankle there is usually swelling of the fingers and toes, especially when local swelling is prevented by a plaster cast If the circulation is brisk, and there is no cyanosis or anæmia, the swelling is of little significance The limb must be elevated until it has subsided Active exercises to prevent joint stiffness are even more important than usual, and patients must be disillusioned of the belief that "the fingers are too swollen to move"

Gangrene—When there is not only swelling but also impairment of the circulation, the position is much more serious If any limb is encased in plaster or splints the circulation must be tested frequently by compressing the tip of each digit, and seeing that the area made anæmic rapidly flushes with blood when pressure is released If the return of blood is slow, the test is repeated every few minutes If the digit remains blue, or is actually cold and pallid, the plaster must be cut at once It is not always necessary to remove any part of the plaster, but it must be cut longitudinally throughout its length, every turn of plaster and bandage being divided until skin is exposed in the gap The gap must then be filled with wool, firmly bandaged in position, in order to prevent blistering of the exposed skin If the circulation is still not restored, the whole of the front half of the plaster must be removed, the back half being relied upon to prevent redisplacement of the fracture If the pressure is not released and the vascular obstruction not relieved, the onset of gangrene may necessitate amputation.

Volkmann's Ischæmic Contracture—Occasionally in fractures of the elbow and upper forearm, even when all external pressure has been relieved, the limb remains swollen and pallid and the radial pulse is weak or absent. Compression of the brachial artery in the antecubital fossa, or injury to its walls, must be suspected

If the condition remains unrelieved, the flexor muscles of the forearm shorten and the fingers contract at the interphalangeal joints If the wrist is flexed so

that the muscles are relaxed, the finger contracture is released, if the wrist is dorsiflexed there is increased tension on the forearm muscles and the contracture is increased The contracture may occur in a localized form, affecting only one or two fingers It must be looked for in all forearm and elbow injuries during the first few days especially when there has been circulatory impairment, by testing the ability of the patient to extend the fingers fully (*Fig* 327) The fully developed contracture causes serious and permanent crippling, and may be associated with paralysis of the ulnar and median nerves

These serious consequences can be avoided only by prompt treatment during the first few hours The surgeon must first satisfy himself that there is no pressure on the artery

Fig 327—Testing for Volkmann's ischæmic contracture in a fracture of both forearm bones immobilized in plaster

Pressure may arise from (1) Tight bandages, strapping, or plaster Encircling bandages must be cut, and if there is an encircling plaster the front half must be removed (2) Flexion of a swollen elbow joint In elbow fractures the only safe position may be 20° or 30° below the right angle (3) Displacement of a supracondylar fracture, the vessels being stretched over the lower end of the shaft The displacement must be reduced, and the position maintained by a posterior plaster slab

If all these factors can be excluded and there is still pallor or cyanosis and absence of the radial pulse, the artery has been damaged and immediate operation may be advisable If the vessel is partly obliterated, periarterial sympathectomy is performed If the vessel is wholly obliterated or completely torn, a one inch segment of it is excised so that the vasoconstrictor nerves are entirely removed

If finger contraction is already developing, shortening of the flexor muscles is minimized by splinting the fingers in extension

Thrombosis—Thrombosis due to injury to the veins sustained at the time of the accident, or during manipulative or operative reduction is rare Femoral thrombosis may complicate hip injuries, and subclavian or axillary thrombosis may occur in injuries of the shoulder The limb should be elevated, and firm elastic pressure applied by crêpe bandages or zinc gelatine paste

Nerve Lesions—Injuries to the nerves are usually sustained at the time of the original injury *Primary nerve lesions are particularly common* in injuries of the elbow, humerus, and shoulder, and in most cases the paralysis is incomplete and due to simple bruising of the nerve-trunk *Secondary nerve lesions* may arise in injuries of the elbow-joint from passive movement of the joint causing friction of the nerve trunk over irregular bone

Pressure Sores—These may develop from undue pressure over bony prominences by splints, bandages, or plaster

Plaster sores may be due to (1) Pulling one turn of the plaster bandage too tightly, (2) Careless moulding of the plaster, (3) Application of a plaster slab which instead of being wet and sloppy has begun to harden, so that it does not adapt itself smoothly to the contour of the limb, (4) Movement of a joint during the setting of the plaster so that a ridge is formed, (5) Before the plaster has firmly set allowing it to rest on a hard surface so that it is flattened over a bony prominence (especially the back of the heel in leg plasters, and over the sacrum in trunk and hip plasters), (6) Pushing coins, heads of knitting needles, small wads of wool, or other foreign bodies down between the plaster and the limb, (7) Delay in repairing a crack in the plaster near the joint, so that there is friction from the broken margins

The patient may complain of persistent localized discomfort and pain. In other cases the skin and subcutaneous tissues become anæmic and anæsthetic, and there is no complaint of pain The first sign may then be the typical smell of accumulated secretions and discharge The pressure sore can usually be localized because the overlying plaster becomes much hotter than elsewhere *Œdema of the toes or fingers recurring after the initial œdema has subsided means almost certainly that there is a pressure sore* If the sore is near the end of the plaster the digits become red and inflamed Finally the sloughing is recognized by the staining of the overlying plaster, or by a purulent discharge from the end of the plaster

As soon as a pressure sore is suspected a window must be cut in the plaster The gap should afterwards be filled with a pad of wool firmly bandaged into position

Purulent Dermatitis—When plaster is applied directly to a limb without padding, the skin usually becomes dry and scaly Some patients have a more susceptible skin and a dermatitis develops which is similar to intertrigo dermatitis, or to the skin irritation sometimes seen beneath strapping Staphylococcal infection of the hair follicles and sweat glands supervenes, and if the condition is ignored a severe and extensive purulent dermatitis follows The first sign is itching and irritation of the skin, and later there is severe burning pain At the first sign of irritation, a small window should be cut, and talcum powder liberally applied and blown under the margins of the plaster every day In severe cases it may be necessary to apply a new plaster over a vaseline gauze dressing

Skin Blistering—This is very common during the first twenty-four hours in the region of severe elbow, leg, and ankle fractures The blisters are due to traumatic œdema and exudation into the cuticle, the exudate sometimes being hæmorrhagic They can develop only where the skin is unsupported If splints are used they appear between the splints and not beneath them, they never develop beneath a complete encircling plaster The blisters should be emptied by pinching the overlying cuticle, and talcum powder dusted over them Plaster may then be applied in the usual way

If a plaster is cut down owing to circulatory difficulty, or a window is cut for a suspected pressure sore, the gap should be filled with a firm pad of wool bandaged into position If this is not done, there will be blistering or œdema of the uncovered area of skin, and sores may develop round the margins of the window

Myositis Ossificans—This is due to the ossification of subperiosteal hæmatomata and occurs most commonly in children, where the periosteum is easily stripped, and after dislocations, where ligaments and muscles are avulsed with their periosteal attachments It is most common at the elbow joint, but it may also occur at the shoulder, hip, knee, or ankle The complication may be avoided by prompt reduction of dislocations, and by avoiding all passive stretching which interferes with the reattachment of the periosteum to the bone (*see* p 277)

Joint Stiffness—Stiffness of the joints from adhesion formation is to be avoided by active exercises and early functional activity If any stiffness does develop, it must be overcome by the patient's own exercise and not by massage or stretching

Stiffness of the elbow joint is very commonly due to passive stretching When a patient is seen with an elbow injury, the parents must be warned at once that the recovery of movement may be slow, but that it will be most rapid and most complete if it is allowed to develop at its own rate *No elbow injury should*

be treated by massage, there must be no single stretching movement, the patient must not be allowed to carry buckets of water or heavy weights with the object of straightening the joint The range of movement should be estimated and recorded week by week by means of an angle measurer (*Fig* 328) If the fracture has been perfectly reduced the movement will steadily increase If the range remains stationary or decreases, the surgeon knows that some type of force or passive stretching is being permitted

The stiff elbow should seldom be manipulated under anæsthesia with the object of regaining mobility If the range of movement is actually measured, it will often be found that manipulation delays recovery, and does not accelerate it Exactly the same is true of stiff finger joints The stiff finger usually becomes stiffer as the result of manipulation under anæsthesia

Fig 328.—The range of joint movement must be measured accurately and recorded.

The harmful effects of passive stretching and manipulation under anæsthesia are most obvious in the elbow and finger joints, but the same principle applies to all joints Movement is regained more rapidly by the patient's own exercise than by passive stretching or by manipulation

Delayed Union—At the conclusion of the usual minimum period of immobilization, union is tested clinically by 'springing' the bone, and it is estimated radiographically If the fracture is not firmly united, plaster is reapplied for a further four to six weeks, and union is again tested In cases of delayed union this routine is repeated as long as may be necessary up to twelve months or longer, or until it is decided that operative treatment is essential

COMPOUND OR OPEN FRACTURES

Emergency Operation—An open fracture is a surgical emergency, and operative treatment is urgent The operation must be undertaken only under the best possible conditions It is not a procedure to be attempted in the casualty department of a hospital Prophylactic injections of antitetanic and anti gas gangrene sera are advisable, and when the initial shock is controlled a local or general anæsthetic is given The wound is covered while the surrounding skin is cleansed with ether soap, ether, and iodine The wound edges are excised, the wound is enlarged in the long axis of the limb, the deep fascia is freely divided, and all bruised, devitalized, and possibly infected tissues are removed No tourniquet is used Hæmostasis is secured by pressure forceps, if possible avoiding catgut ligatures No catgut sutures are buried, and no foreign body must be left in the wound No strong antiseptics are introduced and it should not be irrigated, but 10 g or 15 g of powdered sulphanilamide should be blown into the recesses of the wound

If the operation has been performed within about six hours of injury, and the skin margins can be approximated without tension, it is sometimes safe to suture

the skin with silkworm gut It must be emphasized, however, *that no deep layer of the wound is ever sutured, and that if a surgeon is in doubt as to whether or not to suture the skin, it is better that he should not suture it* If he decides not to suture the skin, the wound is lightly packed with gauze and a complete plaster applied (*see below*—WINNETT ORR TREATMENT) If the skin has been sutured, the wound must be kept under careful observation, and a complete plaster is dangerous A posterior plaster slab is applied and the limb is elevated

The skin stitches should be retained as long as possible If the wound heals by first intention a complete unpadded plaster is applied in two or three weeks, and treatment continued as for a closed fracture

Winnett-Orr Treatment of Infected Fractures—If the operation has failed and the fracture becomes infected, the patient must again be anæsthetized, and the wound reopened and left widely 'saucerized', with free drainage of every part of it down to the medullary cavity of the bone The cavity is lightly packed with sterile gauze which has been impregnated with sterile vaseline The skin is protected with a generous layer of vaseline and vaseline gauze, displacement of the fracture is reduced, and the limb is enclosed in plaster If any part of the skin over which pus will flow has been inadequately protected, a purulent dermatitis will develop, with severe burning pain

The temperature chart must be watched carefully The fever should subside within three or four days, so that the temperature ranges from subnormal to 99° or 99 5° F If the temperature rises acutely over 100° F it means that pus is pocketing under tension The wound must be reopened for drainage of the pocket This should be the only indication for changing the plaster Discharge of pus from the ends of the plaster and the revolting smell of retained discharges are of no significance provided that there is no febrile reaction

The plaster and vaseline pack are changed in four or five weeks, and any sequestra which have separated are removed The treatment is continued with two monthly changes of plaster until the wound is completely granulated and epitheliated and for several months longer until the fracture is united

Gas Gangrene—Every compound fracture sustained on the roads, in pasture lands, or wherever there may be infection from cattle manure, must be suspected of gas-gangrene infection, especially when there is severe muscle or cellular tissue injury, and the emergency operation of wound excision was unduly delayed or imperfectly performed The bacteria, being anaerobic, can develop only in avascular tissue The three typical signs are (1) Swelling, possibly at some distance from the wound, which on palpation is found to crepitate and to be due to gases liberated in the muscles and subcutaneous tissues, (2) Serous discharge from the wound, (3) A typical pungent smell which once recognized is never forgotten

Immediate operation is of the greatest urgency The organism is anaerobic, and if all dead tissue is removed, and every infected region is so freely drained that the tissues regain their normal blood-supply and their normal oxygenation, the infection may be controlled and the limb saved All stitches are removed, and the wound is extended in the long axis of the limb well beyond the limits of infection until it is even ten or more inches in length Other longitudinal incisions may be added Any muscle which is already infected and gangrenous is removed in its entirety, great care being taken not to damage the blood-supply to adjacent tissues and muscles If the gas gangrene infection is controlled, secondary suture of the granulating wound may be performed in ten to fourteen days If

it is not controlled, immediate guillotine amputation is imperative in the attempt to save the life of the patient

GENERAL COMPLICATIONS

Rise of Temperature —An increased temperature is not uncommon for a day or two after severe fractures, even though there is no compound injury and no infection The febrile reaction disappears as the blood clot undergoes absorption

Hypostatic Pneumonia —This may occur in old people, especially those who are somewhat emphysematous It is due to congestion, and its onset is favoured by keeping these patients on their backs The rule, therefore, in treating fractures in elderly people should be never to allow them to remain flat on the back unless there is some very special reason to the contrary They should be well propped up with pillows The first symptoms are usually cough, slight dyspnœa, and possibly some cyanosis and signs of consolidation at the lung bases Stimulants and expectorants must be given, and since there is often cardiac failure as well as pulmonary congestion, digitalis and strychnine are of value

Delirium Tremens —This is a form of mania occurring in alcoholic subjects, especially when suddenly deprived of stimulants of which they have usually partaken freely The earliest symptoms are restlessness and inability to sleep Tremors and twitchings of the tongue and hands are followed by hallucinations, frequently of the reptilian type, delirium, and mania Attacks may be aborted by the judicious administration of alcohol, and hypnotics should be given

Fat Embolism

CHAPTER XLIII

FRACTURES AND DISLOCATIONS OF THE UPPER LIMB

By R Watson-Jones

FRACTURES AND DISLOCATIONS OF THE CLAVICLE

Fractures of the Clavicle occur most commonly in the middle third of the bone There is usually overriding of the fragments, the inner being displaced upwards by the pull of the sternomastoid muscle, and the outer displaced downwards and forwards by the weight of the arm The fragments can only be re-alined and replaced by pulling the whole shoulder girdle upwards and backwards

The difficulty of maintaining perfect replacement of the fragments is shown by the fact that over a hundred different methods have been described Fortunately, however, these fractures almost invariably unite firmly, and the only ill-effect of imperfect reduction is slight bony thickening at the site of injury On the other hand, over zealous attempts to maintain anatomical reduction by immobilization of the shoulder for many weeks are a common cause of serious suffering of the shoulder-joint The articular cartilage and capsule have often been bruised by the injury which fractured the clavicle, and if the joint is immobilized for more than two or three weeks in patients over forty years of age, the suffering will sometimes remain permanently

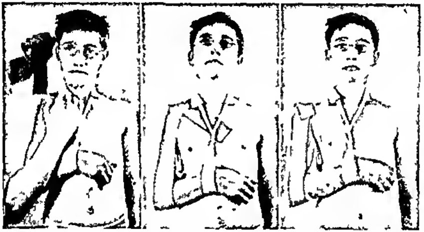
Fig 329 —Fracture of the clavicle immobilized by figure of 8 bandage over large axillary pads The limb is supported in a triangular sling for ten days

The figure-of-8 bandage is simple and effective The patient sits on the front of a stool, the operator standing behind with one foot on the stool and his knee between the patient's shoulder blades A large pad of wool is placed in front of each shoulder, extending into the axilla Several long bandages five or six inches wide are then applied in the form of a figure-of 8, passing in front of the shoulders under the axillæ, and crossing between the shoulder-blades With each turn of the bandage the shoulder girdles are pulled backwards and upwards as strongly as possible without compressing the axillary vessels (*Fig* 329) The bandages may be stitched together to prevent slipping, or alternatively they should be re-applied every second or third day for the first fortnight For the first ten days the shoulder is elevated by a triangular sling tied over the opposite side, but after that time it is left free for exercises The finger-, wrist , and elbow-joints must be exercised frequently from the first day The figure-of 8 bandage may be discarded after three weeks when there is clinical evidence of union , there is

no necessity to wait for radiographic evidence of union, which is much more delayed

Occasionally the fracture is comminuted and a small fragment is tilted out of position, so that a subcutaneous spur develops. Attempts should be made to replace these fragments by direct pressure, *after* the main fracture has been reduced by the figure-of-8 bandage. Even if these attempts fail, operative reduction should still not be contemplated. The sharpest of spurs usually becomes absorbed and rounded, and if any symptoms do remain, it is better to remove the spur after union of the fracture than to attempt open reduction. The only indication for operation in recent fractures is the exceedingly rare complication of compression of the brachial plexus or subclavian vessels by displaced fragments.

Dislocation of the Acromio-clavicular Joint.—If the ligaments of the acromio-clavicular joint are torn, the weight of the arm displaces the shoulder-girdle and acromion downwards below the level of the outer end of the clavicle.



A B C

Fig 330.—Acromio-clavicular dislocation. A, Reducing the dislocation. Strapping is applied in such a way as to elevate the humerus and scapula, and pull down the clavicle. B, Correctly strapped. C, Incorrectly strapped. Reduction is only stable if the strapping lies over the clavicle itself, and not over the point of the shoulder.

Incomplete dislocations (subluxations) are common; more rarely the acromion lies entirely below and in front of the clavicle. The dislocation is easily reduced by elevating the whole arm and shoulder-girdle, but the weight of the limb tends to reproduce the displacement.

A small pad of wool is placed in the axilla, and the wrist is slung from the neck by a collar and cuff with the elbow at the right angle. A pad of adhesive felt or adhesive sorbo rubber is placed below the elbow to protect the bony prominence of the olecranon and the ulnar nerve, and a second pad is placed over the outer end of the clavicle. These two points are then pulled together by strips of brown strapping, four or five feet long, applied as tightly as possible. While the strapping is being applied, the humerus is pushed upwards to elevate the scapula and the acromion, and the clavicle is pulled downwards (*Fig* 330, A). The strapping is easily stretched by the weight of the limb, so that five or six layers should be used one on top of the other. It is a frequent mistake to apply the strapping over the top of the humerus and the shoulder-joint itself, instead of over the clavicle and supraclavicular triangle (*Fig.* 330, B, C).

The strapping must be tightened every second or third day. The original strapping need not be disturbed, but other layers should be applied on top. It is retained for at least three weeks, throughout which time the finger- and wrist-joints are constantly exercised.

DISLOCATION OF THE SHOULDER-JOINT

Dislocation of the shoulder-joint seldom occurs before the age of 20. The capsule is torn on its under surface and the head of the humerus lies below the glenoid fossa, or in front of the glenoid beneath the coracoid process.

The limb must be examined carefully for nerve injuries. The deltoid muscle is often paralysed by injuries to the circumflex nerve, the posterior cord, or the outer trunk of the plexus. The examiner palpates the muscle belly with one hand and instructs the patient to attempt abduction movement against the resistance of his other hand over the patient's elbow. If the nerve-supply is uninjured the muscle is felt contracting even although the shoulder is not actually moved.

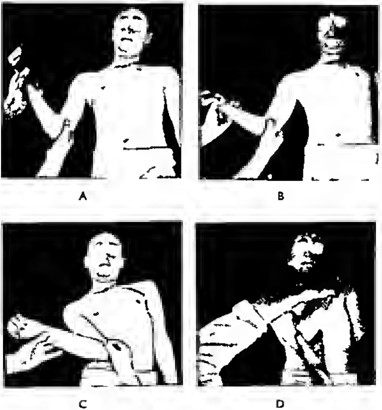


Fig 331.—Kocher's method of reducing a dislocation of the shoulder. A, Traction is applied. B, The humerus is slowly externally rotated; C, It is adducted across the chest. D, It is internally rotated.

Method of Reduction.—The head of the humerus is held in its inwardly displaced and inwardly rotated position by the tension of the subscapularis. To reduce the dislocation this muscle must be stretched slowly and gradually

The patient lies on a couch and the surgeon stands at his side For a dislocation of the right shoulder, the surgeon takes the elbow in his right hand and the wrist in his left (*Fig* 331) Strong, smooth traction is applied to the humerus by pulling with the right hand The arm is then very slowly and gently externally rotated, by moving the wrist outwards, until the normal limit of 90° external rotation is reached Keeping the limb in full external rotation, the elbow is brought forward in front of the chest Finally the limb is internally rotated and the hand brought over to the opposite shoulder The manipulation is performed so smoothly that the head of the humerus glides into position, and often the surgeon does not know at which stage the dislocation was reduced There is no necessity to elicit any click or sudden jerk Frequently such a click does not indicate successful reduction, but is due to movement from one dislocated position to another It is essential that the accuracy of reduction should be confirmed, not only clinically, but also by radiographic examination

Testing for Ruptured Supraspinatus Tendon, and After-treatment —As soon as the dislocation has been reduced, the patient should be asked to abduct the shoulder to the right angled position If he is unable to do so, and yet the deltoid muscle is contracting normally, the loss of power is due to avulsion of the supraspinatus tendon and the limb must be immobilized in an abduction frame or plaster spica (*see below*) If the patient can abduct the shoulder normally, the tendon is intact, and the limb is immobilized by the side for three weeks by a collar and cuff sling and body bandage Immobilization for a shorter period than three weeks predisposes to recurrent dislocation The fingers, hand, and wrist must not be covered, and these joints are exercised constantly After three weeks the patient regains movement at the elbow and shoulder joint by his own exercise There must be no passive assistance by a masseuse, no forcible stretching, and no manipulation under anaesthesia for the breaking down of adhesions These measures increase the stiffness and delay recovery

Dislocation with Fracture of the Tuberosity —Radiographs may show that a large fragment of the great tuberosity has been torn off at the time of the dislocation As a rule the fragment is in perfect position when the dislocation is reduced and treatment is continued as for an uncomplicated dislocation If, however, the post reduction radiograph shows that the tuberosity is still displaced upwards, the limb must be immobilized in a plaster spica in the abducted position

Dislocation with Avulsion of the Supraspinatus.—The tendon retracts away from its point of insertion, and if the arm is immobilized in the usual position by the side, active abduction movement is permanently lost There is no necessity to operate in order to bring the tendon down to the raw surface of bone, it is simpler to bring the raw bone surface up to the retracted tendon As soon as the diagnosis has been established, a frame is applied with the limb in abduction and external rotation This position must be maintained very rigidly, and the patient never permitted to lower the arm, even momentarily, until complete repair of the tendon is proved by the recovery of active abduction and the ability to hold the limb 30° or 40° above the level of the frame If the necessary treatment is instituted promptly, repair should be complete within two or three months but if there has been delay, immobilization for three to six months may be necessary In delayed cases operative suture may be preferable

Dislocation with Paralysis of the Deltoid —If there has been an injury to the circumflex nerve, or to one of the cords of the brachial plexus, the paralysed deltoid muscle must be relaxed by abducting the shoulder on a frame If the patient's arm is firmly bandaged to the frame but the trunk part is loose and can slide down, there is a danger that the joint may be re-dislocated For this reason some surgeons defer the application of the frame for two or three weeks This delay is not necessary if the frame is skilfully applied At least seven or eight 6-in bandages must be used to fix the trunk part of the frame and to hold it up, the turns of bandage being hitched under every hook, screw, and bar, and passed over both shoulders (*see Fig* 336)

FRACTURE OF THE GREAT TUBEROSITY OF THE HUMERUS

Contusion Fractures.—As a result of a direct fall on the shoulder the great tuberosity may be comminuted. A large fragment of bone is separated but not displaced (*Fig* 332). There is no necessity to use an abduction frame. The arm may be supported in a sling for ten days, and the limb should then be used for all ordinary purposes. Full movement of the shoulder is regained in two to three months.

Fig 332.—Contusion fracture of the great tuberosity of the humerus without displacement.

Fig 333.—Avulsion fracture with displacement.

Avulsion Fractures.—A small flake of bone is pulled off the tuberosity by traction of the supraspinatus muscle. The fragment may be retracted so that it lies above the head of the humerus (*Fig* 333). The limb must be immobilized in a frame or plaster spica, in the position of 90° abduction and at least 60° external rotation, for two to three months, until it can be raised actively to 30° or 40° above the level of the frame. Throughout this time exercises must be practised for every other joint of the limb.

FRACTURE OF THE NECK OF THE HUMERUS

Three types of fracture must be distinguished: (1) Contusion crack fractures; (2) Adduction fractures; and (3) Abduction fractures (*Fig* 334).

A B C

Fig 334.—Fractures of the neck of the humerus. A, Contusion crack fracture. B, Adduction fracture. C, Abduction fracture.

Contusion Crack Fractures—The injury follows a fall on the outer aspect of the shoulder, and the crack across the neck of the humerus is often associated with a comminuted fracture of the tuberosity Complete immobilization is not necessary The limb should be supported in a sling for two or three weeks, throughout which time the finger-, wrist, and elbow joints are exercised As soon as the swelling and bruising of the shoulder have begun to subside, active exercises are practised

Adduction Fractures—These occur equally commonly in adults and in children, and the fragments are impacted in such a way that the shaft is adducted on the head If the displacement is not corrected, abduction movement is permanently limited by a degree corresponding with the degree of angulation

Fig 335—*Abduction frame with arm traction for fractures of the shaft and certain fractures of the neck of the humerus*

In elderly patients this is unimportant and the impaction should not be broken down by manipulation Treatment is carried out exactly as for contusion crack fractures

In younger patients the displacement is reduced by traction on the limb in the abducted position, so that the adduction angulation is corrected The limb is immobilized on a frame, in right angled abduction, for 4 to 5 weeks

Abduction Fractures—These fractures occur less commonly in children than in adults The shaft is slightly abducted on the head and the great tuberosity is pinched off by compression between the head and the outer margin of the shaft In most cases the displacement is of minimal degree, and there is no

necessity for manipulative reduction The injury is treated in the same way as simple crack fractures, by protection in a sling for two or three weeks, followed by active exercises

In a few cases the degree of abduction displacement at the time of the injury is so extreme that the shaft is driven inwards beneath the head and completely detached from it There is no apposition between the fractured surfaces, and the loose head is fully abducted and externally rotated by the unopposed pull of the muscles inserted into the tuberosity The displacement must be reduced by adducting the shaft across the chest, and pushing the upper end of the shaft outwards, by means of a hand in the axilla, until the fractured surfaces engage The arm is then brought to the side and immobilized by the side for about four weeks before active shoulder movements are begun

If the manipulation fails to secure complete engagement of the fractured surfaces, the proximal fragment remains fully abducted, and externally rotated. In this event the shaft of the humerus must also be abducted and externally rotated It must be recognized, however, that the original displacement was produced by abduction, and that, if an ordinary frame is used, the shaft will continue to lie under the head If it unites in this position it may prove impossible to bring the arm down to the side, and a most serious deformity results *If an abduction fracture is treated in the abducted position, continuous traction is essential, and a special traction abduction frame must be used* (*Fig* 335) The frame is adjusted

Fig 336 —Applying an abduction frame To prevent the frame from sliding down the trunk, it must be firmly bandaged over both shoulders.

so that the limb is in abduction, external rotation, and forward flexion, and special care must be taken that the frame does not slide down the trunk (*Fig* 336) Frequent check radiographs are necessary The frame is jointed so that elbow movements may be practised, and the forearm, wrist, and finger joints must be regularly exercised

STIFFNESS OF THE SHOULDER FROM PERIARTICULAR ADHESION FORMATION

Fractures and dislocations, or simple contusions and sprains of the shoulder, are often followed by adhesion formation between the plications of the joint capsule, which causes limitation of external rotation and abduction movement

It is the limitation of external rotation which is of significance The normal shoulder-joint cannot be abducted beyond a right angle if the humerus is held internally rotated, outward rotation is an essential component of abduction movement Every upper limb which is supported in a sling is immobilized with the shoulder *in full internal rotation* The resulting limitation of outward rotation may be demonstrated with the elbow to the side and the forearm and hand directed forwards Normally it is possible to rotate the limb outwards through almost 90°, so that the forearm and hand point sideways *If this movement* is completely limited, it is a waste of time to practise abduction exercises, external rotation exercises must first be practised, by keeping the elbow to the side and turning the forearm more and more outwards The patient must also try to reach the back of his neck As this movement recovers, he endeavours to reach over the top of the head to the opposite ear He may then practise crawling up a wall with his finger-tips, marking the level reached, and endeavouring to reach a higher level every day The exercises must be performed by the patient himself five minutes hourly throughout the day Many patients require encouragement and stimulation, *but there must be no passive stretching by a masseuse or relative The exercises must be done smoothly, without sudden jerking or forcible movements The patient must not hang by the affected arm from overhead beams or parallel bars so that body-weight exerts passive stretching* Whenever possible, manipulation under anæsthesia must be avoided *Forcible manipulation is the last line of* treatment, to be applied only when actual measurements show that movement is no longer increasing despite regular active exercise If a manipulation is inevitable, only one group of adhesions should be broken at a time If too much is done, the reaction is so severe that the movement cannot be retained, and the joint may even become stiffer After manipulation, passive stretching by a masseuse must again be avoided *Passive stretching of a stiff shoulder joint is the most common cause of permanent stiffness*

FRACTURE OF THE SHAFT OF THE HUMERUS

Fractures of the shaft of the humerus which are adequately reduced show little tendency to redisplacement For this reason it is usually sufficient to use a simple collar and-cuff sling, with three or four gutter splints (*Fig* 318), or two plaster slabs, to immobilize the fragments and prevent angulation It is true that gutter splints or a plaster slab do not afford absolute immobility of the fragments, but in most fractures of the shaft of the humerus, the tendency towards union is so strong that firm union still takes place in five or six weeks, and more complete immobility is unnecessary Occasionally, however, the blood-supply of one fragment is impaired, and union is very slow At the fifth week, far from union being complete, clinical examination shows that it has scarcely begun Unless the fracture is more completely immobilized, slow union will be complicated by non-union A complete shoulder plaster spica must be applied, closely moulded to the limb, absolute immobility being maintained for many weeks or even months, until clinical tests show firm union The shoulder- and elbow-joint are then mobilized by the patient's own active exercise

Musculospiral Palsy.—If the musculospiral nerve has been damaged, stretching of the extensor muscles of the forearm must be prevented by supporting the wrist in moderate dorsiflexion, A long cock-up splint which immobilizes the finger joints in the fully extended position must not be used, because it so often causes serious stiffness of the fingers, and this may prove even more disabling

than the paralysis itself If there is no sign of recovery of the nerve lesion within two or three weeks, exploration is advisable, because the nerve-trunk has sometimes been severed by the sharp bone fragments and nerve suture is essential.

SUPRACONDYLAR FRACTURES OF THE HUMERUS

Types of Fracture.—There are two types of supracondylar fracture—the usual type where the lower fragment is displaced backwards, and the less common type in which it is displaced forwards In the more usual variety the line of fracture runs obliquely upwards and backwards, the displacement is reduced by flexing the elbow, and in this position the fragments lock securely (*Fig* 337) In the opposite type the fracture line is oblique downwards and backwards If the

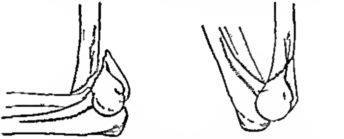


Fig 337—Supracondylar fracture of the usual type, with backward displacement of the small fragment. Reduction is only stable if the elbow is flexed.

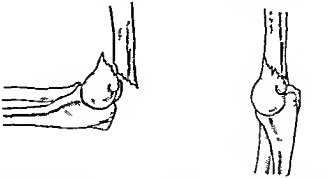


Fig 338—The less common type of supracondylar fracture, in which there is forward displacement of the lower fragment. Reduction is only stable if the elbow is fully extended.

elbow is flexed the displacement is increased, and the fragments lock only in the extended position (*Fig* 338) It is obviously wrong to treat all supracondylar fractures with the elbow flexed The common type must be treated in this position, but the opposite type must be treated in the opposite position

Importance of Perfect Reduction.—Accurate reduction with complete correction of the tilting of the lower fragment is of the utmost importance The axis of this fragment determines the position of the forearm, and the range of movement of the elbow If the fragment unites with forward tilting, extension of the elbow will be permanently limited by a corresponding degree. If the fragment unites with backward tilting, there will be a greater range of extension

than normal, and flexion will be permanently limited If lateral tilting remains uncorrected, the carrying angle of the forearm is altered and there is obvious deformity These angulations do not undergo correction with subsequent growth of the bone The absorption of bony spurs may make them less conspicuous in the radiograph, but the limitation of movement, and the deformity of the elbow with alteration of the carrying angle, persist into adult life

Supracondylar Fracture with Backward Displacement—The most important part of the manipulative reduction is traction applied in the long axis of the limb In the common type with backward displacement, while traction is maintained, the elbow is gradually flexed to almost 45° above the right angle Lateral displacement is then corrected An assistant holds the limb by the wrist, keeping the elbow flexed, and the surgeon applies direct lateral pressure with one hand over the shaft of the humerus and the other hand on the opposite side of the limb over the displaced fragment itself The circulation is at once tested, and if the swelling of the joint is so severe that 45° of flexion has compressed the radial artery or the veins, the elbow must be extended until the pulse and venous return are normal A plaster cast is applied over the back of the limb and lightly bandaged into position, taking care to avoid the slightest pressure over the front of the joint The limb is slung from the neck by a collar-and-cuff

Immediate radiographic examination is essential, and if the displacement is not completely corrected, the fracture is at once remanipulated Full ether anæsthesia should be used, with a portable X-ray machine in the plaster-theatre, so that three or four or more manipulations may be performed if necessary

Supracondylar Fracture with Forward Displacement—If the fracture is of the opposite type, traction is applied and the limb is extended until the elbow is quite straight Lateral displacement is corrected as before, and a plaster cast applied from below the shoulder to just above the wrist While the patient is up and about the limb hangs by the side, but swelling of the fingers and hand must be avoided by elevating the limb on cushions as soon as he sits or lies down

After-treatment—If the joint was severely swollen at the time of reduction, a check radiograph seven days later is very important It may be necessary to apply a new plaster cast to avoid recurrence of displacement The finger-joints must be moved actively at once, and gentle shoulder exercises should begin after seven to ten days *The elbow is immobilized for four weeks*, and the patient is then allowed to regain movement by his own exercises There must be no massage, no passive stretching, and no carrying of heavy weights (*See* pp 280–282, VOLKMANN'S CONTRACTURE, NERVE LESIONS, MYOSITIS OSSIFICANS, JOINT STIFFNESS)

FRACTURE OF THE EXTERNAL CONDYLE OF THE HUMERUS

This injury occurs usually in children of five to fifteen years of age A perfect recovery can be achieved, but failure to apply the correct treatment leads inevitably to non-union, to an appalling deformity, and sometimes to ulnar paralysis supervening ten to twenty years later The separated fragment includes the capitellum and outer part of the trochlea, the external lateral ligament and the extensor muscle origin remain attached to it The tension of the muscle tilts the fragment out of the elbow-joint, and rotates it so that the fractured surface is directed outwards (*Fig* 339) Sometimes it turns completely upside down,

and the articular surface of the fragment lies opposite the fractured surface of the shaft of the humerus Under these circumstances bony union is obviously impossible, and a weak fibrous union results, with a completely unstable elbow joint.

Fig 339—Fracture of the external condyle of the humerus The condylar fragment is tilted out of the joint by the pull of the extensor muscles

As years go on, the forearm bones become displaced more and more to the outer side of the humerus, until the carrying angle may be as much as 60° or 70° Gradual stretching of the ulnar nerve round the inner side of the elbow accounts for the delayed ulnar palsy

The displacement is easily seen in the antero-posterior radiograph. In children, where the epiphyses are not yet fully ossified, it must be recognized that the fragment shown in the radiograph is merely the ossific nucleus of a very much larger cartilaginous fragment

Manipulative Reduction.—This may be possible within a few days of the injury An assistant holds the limb by the wrist with his other hand on the inner aspect of the elbow, and gently opens the joint on the outer side so that the limb is in slight cubitus varus The surgeon places one or both thumbs beneath the fragment and pushes it upwards and inwards, tilting it into the joint The elbow is then flexed, and the two condyles of the humerus are strongly compressed laterally so that the fragment is firmly pressed into its bed Reduction is usually stable, but a plaster cast may be used in addition to a collar and-cuff sling The after-treatment is the same as for supracondylar fractures

Operative Reduction—If the fragment is not perfectly replaced, the joint must be opened on the outer side, the fragment replaced, and held in position by catgut suture There is no necessity to peg or screw the fragment to the humerus

FRACTURES OF BOTH CONDYLES OF THE HUMERUS (T AND Y FRACTURES)

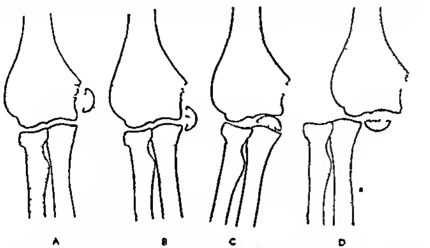
This injury consists of a high supracondylar fracture, with a second vertical fracture line extending into the joint, separating both condyles It is sometimes comminuted, and usually occurs in elderly patients from a fall on the point of the elbow

The displacement is reduced by traction and direct lateral compression of the fragments A plaster cast is applied, well moulded to the inner and outer aspects of the joint, in order to prevent recurrent tilting of the fragments with distortion of the joint surface As a rule the elbow is held in right angled flexion and the limb is suspended by a collar and-cuff sling In some cases the flexed or right angled position tilts the condylar fragments forwards so that extension movement of the joint would remain limited. In this event the cast must be applied with the elbow fully extended Since the injury occurs in elderly patients, it is particularly important to preserve full finger and shoulder movements Only if a plaster cast has been used, in addition to a collar and-cuff sling, can early shoulder exercises be practised with safety

If the fracture is so comminuted that the joint surface is completely broken up, operative treatment may sometimes be advisable Unfortunately open reduction and fixation with plates, screws or wire seldom avoids the penalty of serious permanent stiffness of the joint, and it may be better to perform an immediate excision-arthroplasty

FRACTURE OF THE INTERNAL EPICONDYLE OF THE HUMERUS

The internal epicondyle of the humerus may be fractured by direct violence but more often the epicondyle or its epiphysis is avulsed by the common flexor group of muscles (*Fig* 340) Slight displacement of the fragment is of no significance, and operative treatment is not necessary, union of the fragment may be



A B C D

Fig 340—Separation of the epiphysis of the internal epicondyle A Minimal displacement B Marked displacement—operative fixation is usually advisable C, Inclusion within the elbow joint—operative replacement is imperative D Displacement associated with dislocation of the elbow joint—care must be taken in reducing the dislocation not to include the epiphysis within the joint.

fibrous and not bony, but this does not usually impair the functional result If the fragment is widely displaced, or rotated away from the humerus it should be replaced through a short incision and fixed with catgut sutures The associated traumatic synovitis of the joint necessitates immobilization by a collar and cuff sling for three weeks, and movement is then regained by the patient s own exercise The recovery of full extension is sometimes slow, and even twelve months may elapse before movement is normal Passive methods, or manipulation under anæsthesia, must be avoided because they delay the recovery still more

Inclusion within the Elbow-Joint—If the fragment is displaced into the elbow joint its immediate replacement is imperative In early cases it may be dislodged from the joint by manipulation but in other cases operation is necessary The fragment should not be pinned or nailed into position, any foreign body other than absorbable catgut causes irritation of the elbow joint, with recurrent exudation and dense adhesion formation

Ulnar Palsy.—Since the epicondyle is displaced by the stretching open of the inner side of the joint there is frequently a coincident traction injury of the ulnar nerve, with paralysis which is usually incomplete Transportation of the nerve from the irregularly thickened post-condylar groove to the front of the joint is sometimes necessary

DISLOCATION OF THE ELBOW-JOINT

As a rule both radius and ulna are dislocated backwards, either directly backwards, backwards and outwards, or backwards and inwards The injury is often

associated with avulsion of the internal epicondyle or its epiphysis It is important to recognize this complication before reducing the dislocation, in order to avoid imprisoning the small fragment within the inner side of the joint In other cases there may be a comminuted fracture of the head of the radius Forward dislocation of both radius and ulna together with a fracture of the olecranon is a less frequent injury

Reduction and After-treatment—Backward dislocations are easily reduced by applying traction to the forearm and gradually flexing the elbow The wrist is suspended from the neck by a collar and cuff sling, and the joint is immobilized for three weeks, throughout this time movements of the fingers and shoulder must be practised Radiographs *must* be taken after manipulation, to confirm the accuracy of reduction, to be sure that the internal epicondyle is not displaced within the joint, and to exclude fracture of the head of the radius necessitating operative treatment (*see* below) Movement of the elbow is regained by the patient's own gentle exercise, with no massage, no passive stretching, and no weight carrying The range of movement should be measured and recorded week by week

Myositis Ossificans—This complication is due to ossification of a hæmatoma beneath periosteum which has been avulsed by muscles or capsule (*see* p 282) It is most commonly seen after dislocation of the elbow, usually when passive stretching has been employed

The first sign of the complication is the radiographic evidence of a cloudy shadow in the front of the joint The shadow gradually becomes more dense and consolidated but since the hæmatoma is continually absorbing the final bony mass is much smaller than the original shadow

In the treatment of myositis ossificans, the absolute immobility sometimes recommended is neither necessary nor advisable The tearing away of periosteum and the hæmatoma formation are the result of passive stretching, not of active exercise The only treatment necessary is to prohibit passive stretching Recovery is no more rapid if active exercise is prohibited and the joint completely immobilized in plaster On the other hand, complete immobility allows consolidation of the adhesions which have also occurred from the passive stretching, and stiffness and limitation of extension are then inevitable

FRACTURES OF THE HEAD OF THE RADIUS

Fractures of the head of the radius may appear insignificant, but are of considerable gravity If treated inexpertly, even simple marginal chips may cause serious incapacity The injury usually follows a fall on the outstretched hand, and is often overlooked The diagnosis is based on the tenderness over the head of the radius, limitation of extension of the elbow, and pain on radio-ulnar movement

Crack Fractures without Displacement—These require rest by means of a triangular sling, or collar and cuff, for two or three weeks, followed by active exercises The fracture involves the joint surfaces of the elbow, and passive stretching is disastrous Stretching for only three or four weeks often causes permanent limitation of extension movement

Displaced Marginal Fractures—If a marginal sector of the head of the radius is displaced so that the radio humeral joint surface is broken up and irregular, early operative removal of the head of the radius is advisable It will often be found that the articular surface of the capitellum opposite the head of

the radius is also damaged and loose fragments may be separated The ideal time for operation is ten to fourteen days after injury, if it is arranged earlier, considerable ossification may occur in the blood clot; if it is deferred until later, the damage to the joint from articulation of roughened surfaces has already been done, and delayed removal of the bone after many weeks or months will not restore full movement

Comminuted Fractures.—If the whole head of the radius is comminuted, there is breaking up of the radio ulnar as well as of the radio-humeral joint surfaces Unless the head of the radius is removed within the first two or three weeks, there will be permanent limitation of pronation-supination movement as well as of extension movement

Post-operative Treatment.—After operation, treatment is continued as for fractures of the head of the radius without displacement The recovery of movement may be very slow, but the temptation to accelerate recovery by massage, stretching, or manipulation under anæsthesia must be rigidly avoided However slow recovery may be, it will be still more slow if these measures are permitted, and *permanent limitation of extension movement will result*

FRACTURE OF THE OLECRANON

Fractures of the olecranon process extend into the sigmoid notch and involve the elbow-joint surface If the gap between the fragments is not closed and a smooth joint surface restored, stiffness of the elbow and painful movement remain If the fragments are not immobilized in perfect apposition for at least four to six weeks, fibrous union will result, with impairment of active extension of the elbow against resistance

Manipulative Treatment.—An attempt should be made to secure perfect apposition by manipulation The elbow is fully or almost fully extended and firm pressure applied over the detached fragment, pushing it forwards and downwards into the angle from which the triceps has pulled it A plaster cast is applied from below the shoulder to just above the wrist The limb must be elevated whenever possible to avoid gravitational œdema of the fingers and hand

Operative Treatment.—If manipulation fails to secure close apposition of the fragments and to restore a smooth joint surface, operative reduction and fixation by catgut suture *is necessary*, *or alternatively*, the detached fragment is excised and the triceps stitched to the ulna Wire, screws, and other irritant and non-absorbable foreign bodies should be avoided After the fragments have been sutured, it is usually safe to flex the elbow to about 30° below the right angle The limb is immobilized in plaster for six weeks, throughout which time full finger and shoulder exercises are practised Elbow movement is restored by the patient's own exercise

Fractures of the Olecranon with Forward Dislocation—Occasionally after a fall on the back of the forearm the olecranon is fractured and both forearm bones are dislocated forwards The ulnar nerve may be damaged by traction over the lower end of the humerus The dislocation is easily reduced by applying traction, extending the elbow, and pressing backwards on the front of the upper forearm The fracture of the olecranon is then treated in the usual way

FRACTURES OF THE SHAFTS OF THE RADIUS AND ULNA

One or both of the forearm bones may be fractured in any part of the shaft *If a fracture of the radius lies above the insertion of* the pronator radii teres, the proximal fragment is fully supinated by the unopposed action of the supinator brevis and the biceps The distal fragment must therefore be held in a similar

associated with avulsion of the internal epicondyle or its epiphysis It is important to recognize this complication before reducing the dislocation, in order to avoid imprisoning the small fragment within the inner side of the joint In other cases there may be a comminuted fracture of the head of the radius Forward dislocation of both radius and ulna together with a fracture of the olecranon is a less frequent injury

Reduction and After-treatment.—Backward dislocations are easily reduced by applying traction to the forearm and gradually flexing the elbow The wrist is suspended from the neck by a collar and-cuff sling, and the joint is immobilized for three weeks, throughout this time movements of the fingers and shoulder must be practised Radiographs *must* be taken after manipulation, to confirm the accuracy of reduction, to be sure that the internal epicondyle is not displaced within the joint, and to exclude fracture of the head of the radius necessitating operative treatment (*see* below) Movement of the elbow is regained by the patient's own gentle exercise, with no massage, no passive stretching, and no weight-carrying The range of movement should be measured and recorded week by week

Myositis Ossificans.—This complication is due to ossification of a hæmatoma beneath periosteum which has been avulsed by muscles or capsule (*see* p 282) It is most commonly seen after dislocation of the elbow, usually when passive stretching has been employed

The first sign of the complication is the radiographic evidence of a cloudy shadow in the front of the joint The shadow gradually becomes more dense and consolidated, but since the hæmatoma is continually absorbing, the final bony mass is much smaller than the original shadow

In the treatment of myositis ossificans, the absolute immobility sometimes recommended is neither necessary nor advisable The tearing away of periosteum and the hæmatoma formation are the result of passive stretching, not of active exercise The only treatment necessary is to prohibit passive stretching Recovery is no more rapid if active exercise is prohibited and the joint completely immobilized in plaster On the other hand, complete immobility allows consolidation of the adhesions which have also occurred from the passive stretching, and stiffness and limitation of extension are then inevitable

FRACTURES OF THE HEAD OF THE RADIUS

Fractures of the head of the radius may appear insignificant, but are of considerable gravity If treated inexpertly, even simple marginal chips may cause serious incapacity The injury usually follows a fall on the outstretched hand, and is often overlooked The diagnosis is based on the tenderness over the head of the radius, limitation of extension of the elbow, and pain on radio-ulnar movement

Crack Fractures without Displacement.—These require rest by means of a triangular sling, or collar-and-cuff, for two or three weeks, followed by active exercises The fracture involves the joint surfaces of the elbow, and passive stretching is disastrous Stretching for only three or four weeks often causes permanent limitation of extension movement

Displaced Marginal Fractures—If a marginal sector of the head of the radius is displaced so that the radio-humeral joint surface is broken up and irregular, early operative removal of the head of the radius is advisable It will often be found that the articular surface of the capitellum opposite the head of

the radius is also damaged and loose fragments may be separated The ideal time for operation is ten to fourteen days after injury, if it is arranged earlier, considerable ossification may occur in the blood clot, if it is deferred until later, the damage to the joint from articulation of roughened surfaces has already been done, and delayed removal of the bone after many weeks or months will not restore full movement

Comminuted Fractures—If the whole head of the radius is comminuted, there is breaking up of the radio-ulnar as well as of the radio humeral joint surfaces Unless the head of the radius is removed within the first two or three weeks, there will be permanent limitation of pronation supination movement as well as of extension movement

Post-operative Treatment—After operation, treatment is continued as for fractures of the head of the radius without displacement The recovery of movement may be very slow, but the temptation to accelerate recovery by massage, stretching, or manipulation under anæsthesia must be rigidly avoided However slow recovery may be, it will be still more slow if these measures are permitted, and permanent limitation of extension movement will result

FRACTURE OF THE OLECRANON

Fractures of the olecranon process extend into the sigmoid notch and involve the elbow joint surface If the gap between the fragments is not closed and a smooth joint surface restored, stiffness of the elbow and painful movement remain If the fragments are not immobilized in perfect apposition for at least four to six weeks, fibrous union will result, with impairment of active extension of the elbow against resistance

Manipulative Treatment—An attempt should be made to secure perfect apposition by manipulation The elbow is fully or almost fully extended and firm pressure applied over the detached fragment, pushing it forwards and downwards into the angle from which the triceps has pulled it A plaster cast is applied from below the shoulder to just above the wrist The limb must be elevated whenever possible to avoid gravitational œdema of the fingers and hand

Operative Treatment—If manipulation fails to secure close apposition of the fragments and to restore a smooth joint surface, operative reduction and fixation by catgut suture is necessary, *or alternatively*, the detached fragment is excised and the triceps stitched to the ulna Wire, screws and other irritant and non absorbable foreign bodies should be avoided After the fragments have been sutured, it is usually safe to flex the elbow to about 30° below the right angle The limb is immobilized in plaster for six weeks, throughout which time full finger and shoulder exercises are practised Elbow movement is restored by the patient's own exercise

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position, and the limb is immobilized in full supination If the fracture of the radius lies below the insertion of the pronator radii teres, the proximal fragment has both supinator and pronator muscles attached to it The limb must then be immobilized in the position midway between full supination and full pronation. As a rule the elbow is held at the right angle

Method of Reduction—Overriding and angulation of the fragments is reduced by strong and prolonged traction Counter-traction should be arranged by passing a sling of calico bandage over the front of the arm just above the flexed elbow An assistant takes the patient's fingers in one hand and the thumb in the other, and pulls steadily for several minutes If the fingers are moist and slippery, adhesive plaster is applied so that a firmer grip is secured If the injury is several days old, traction may be necessary for fifteen minutes, or even longer, before reduction is perfect The surgeon applies direct pressure to the fragments and moulds them into position An unpadded plaster cast is then applied from the upper arm just below the shoulder to the knuckles, not extending into the palm beyond the oblique skin creases The calico bandage sling used for counter-traction must be entirely removed before the plaster is completed, so that no pressure remains over the vessels in the antecubital fossa The cast is carefully moulded to the forearm and wrist, because redisplacement sometimes occurs even in unpadded plasters (*Fig* 341)

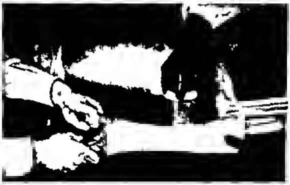

Fig 341—Reduction of fracture of shafts of both forearm bones

After-treatment.—Reduction must be confirmed by X rays, and check radiographs taken every second week for the first two months It is usually necessary to apply a new plaster two to three weeks after reduction, when the swelling has subsided During the first few days the hand is elevated with the fingers pointing to the ceiling in order to minimize reactionary swelling The circulation and movements of the fingers must be carefully watched, because of the danger of Volkmann's contracture (*see* p 280) If there is cyanosis or pallor of the fingers, or difficulty in fully extending them, the plaster is at once cut longitudinally from the front of the wrist to above the elbow When the circulation is again normal, the plaster may be repaired. The average minimal period of immobilization is six weeks in children and ten weeks in adults Full movements of the fingers and shoulder are praensed throughout

Non-union of the Shaft of the Ulna—Non union is often seen in fractures of the shaft of the ulna at the junction of the middle and lower thirds, but it is

always due either to inadequate immobilization or to immobilization for too short a period In some cases a below-elbow plaster cast which does not prevent rotatory movement of the fragments has been relied upon In other cases a complete cast above the elbow has been replaced after six or eight weeks by a below elbow plaster The union which had developed during the first few weeks was broken down by the rotatory movements subsequently permitted The complete cast from the upper arm to the knuckles must be retained until there is radiographic evidence of union of the fracture

Fractures of the Upper Third of Both Bones—When the fracture lies high in the forearm the flexed position of the elbow may tend to produce a similarly flexed position of the fragments—a backward angulation In these circumstances the elbow should be fully extended and plaster applied with the limbs in this position

Fractures of the Upper Shaft of the Ulna with Dislocation of the Head of the Radius—The head of the radius is dislocated forwards and outwards, and there is forward and outward angulation of the ulna Reduction is difficult, and even despite immobilization in plaster, redisplacement often occurs It is often necessary to plate the ulna No early operation should be performed on the dislocated radial head because it increases the tendency to myositis ossificans, late excision is sometimes necessary

Fracture of the Lower Shaft of the Radius with Inferior Radio-ulnar Dislocation—This is a relatively common injury, and there is a strong tendency to redisplacement, the radius angulating towards the ulna, and the inferior radio ulnar joint again dislocating It must be reduced by traction on the radius applied through the thumb The limb is immobilized with the wrist deviated as far as possible to the ulnar side The plaster must be very closely moulded round the radius and wrist joint, and carried well down the radial side of the hand over the thumb and index metacarpals A hook of metal is incorporated in the plaster, extending beyond the thumb, and skin traction is applied by strapping on the thumb attached to the hook (*see Fig* 350) Frequent check radiographs are imperative

The use of traction wires or steel pins penetrating both forearm bones and incorporated in the plaster is not recommended, but operative fixation of the radius by a vitallium transfixion screw may be needed

COLLES'S FRACTURE OF THE RADIUS

Method of Reduction—It is possible to correct both backward and outward displacement by one twisting movement which pronates the lower fragment, but it is more satisfactory to correct each displacement separately by two distinct manœuvres To reduce a right Colles's fracture, the surgeon grasps the lower fragment in his left hand, securing a grip between his thenar eminence on the back of the fragment and his finger tips on the front (*Fig* 342) By counter-pressure with his other hand on the front of the forearm, the fragment is tilted and pushed forwards as strongly as possible A new grip is then taken to correct the radial displacement The surgeon places his right thenar eminence over the patient's radial styloid process, and his finger tips over the ulnar side of the joint, and with his other hand on the opposite side of the limb the radial fragment is tilted and pushed inwards towards the ulna (*Fig* 343) It is impossible to over correct the displacement however strongly the surgeon manipulates

An assistant holds the limb, taking the patient's thumb in one hand and fingers in the other, and maintains strong traction The surgeon applies a

dorsal plaster slab directly to the skin, from the back of the knuckles to just below the fold of the elbow An encircling plaster bandage may also be applied. The plaster must extend over the radial side of the thumb metacarpal to the base of

Fig 342.—Reduction of Colles's fracture Correction of backward displacement.

Fig 343.—Reduction of Colles's fracture Correction of radial displacement.

the thenar eminence, and over the front of the wrist joint to below the scaphoid tubercle, but not actually into the palm *While the plaster is setting, the surgeon must again grasp the wrist and mould the plaster very closely round the radius, reproducing the normal concavity of the lower end, and pushing the carpus and lower radial fragment forwards and inwards* (Fig 344) Unless the plaster is closely moulded to the bone, redisplacement will occur and the fracture will unite with radial deviation

Fig 344.—Reduction of Colles's fracture While the plaster is setting the radial concavity is reproduced by the fingers of the left hand and the lower fragment is pushed forwards and inwards with the right hand

After-treatment.—The hand is lightly bandaged or strapped to the dorsal plaster There must be nothing in the palm except strapping or bandage, and full finger and shoulder exercises are practised at once (*see* p 276) If the fingers are swollen the limb is elevated until the œdema has subsided. A sling may be worn for 24 to 48 hours, the arm is then put through the sleeve of the clothes and used in the ordinary way for light activities The plaster must be retained for five weeks If the limb was very swollen when the fracture was reduced, a new plaster is necessary seven to ten days later Wrist and forearm movements recover by the patient's own activity within a few weeks of removing the plaster

Displaced Lower Radial Epiphysis.—The same injury sustained in children causes a backward and outward displacement of the lower radial epiphysis The clinical signs, method of reduction, and after treatment are the same as for Colles's fracture The injury is to be regarded as a fracture adjacent to the epiphysial

line It seldom causes arrested growth of the radius such as occurs after compression of the epiphysial disc

Comminuted Colles's Fracture—The lower fragment of the radius may be comminuted and the wrist joint surface broken up by the fragmentation Comminution must not be accepted as an excuse for failure to reduce Irregularity of the joint surface makes it still more imperative to secure perfect reduction, so that joint movement will be smooth and painless Spreading of the fragments is corrected by compression between the operator's two hands in both the antero posterior and the lateral axes It is usually possible to secure a perfect reduction and to restore a smooth articular surface

Fracture of the Radial Styloid—The same manipulative manœuvre is used in fractures of the base of the radial styloid process This is a common backfire injury, and since the fracture extends into the joint, accurate reduction is essential Direct compression manipulation is also used to reduce posterior and anterior marginal fractures of the lower end of the radius

Spontaneous Rupture of Thumb Tendons—The extensor pollicis longus tendon lies in a groove on the back of the lower end of the radius A sharp spicule of bone in this groove may cause fraying and spontaneous rupture of the tendon In posterior marginal articular fractures, and comminuted Colles's fractures the patient should therefore be warned not to practise too energetic movement of the thumb during the first three weeks Actually the complication usually occurs in overlooked fractures, where wrist movements are permitted as well as thumb movement

Reversed Colles's Fracture—In more uncommon cases the lower fragment of the radius is displaced forwards and not backwards The displacement is reduced by pushing the fragment backwards and dorsiflexing the wrist The fracture line is usually oblique, and the displacement cannot be over-reduced however strongly it is manipulated A plaster cast is applied in the usual way and the wrist immobilized for five weeks

FRACTURE OF THE CARPAL SCAPHOID BONE

The scaphoid bone is commonly fractured by backfire injuries, and by falls on the outstretched hand If it is properly treated a perfect recovery is possible within two or three months If treatment is delayed, the incapacity period is prolonged to six or twelve months If the wrist is not immobilized at all, non-union is inevitable, the wrist is permanently weakened, and arthritis with a very serious disability may supervene several years later Early diagnosis is therefore of great importance Unfortunately the injury is often regarded as a sprain and the fracture is overlooked

Diagnosis—Sprain of the wrist is almost an unknown injury Nearly every so called sprain is actually a fracture *Every patient who injures the wrist and complains of pain and tenderness over the radial side of the joint, must be assumed to have sustained a fracture of the scaphoid until radiographs prove otherwise* The radiograph may show only the very finest hair-line crack The crack may be obvious only when seen through a magnifying lens This is a complete fracture and it must not be ignored If the bone is not immobilized, even the finest crack will gradually widen until a gap appears (*Fig* 345) and non-union develops *If a fracture of the scaphoid is suspected, three radiographs must be taken, including an oblique view as well as the classical antero posterior and lateral views If the crack does not appear even in the oblique view, the surgeon must still not be satisfied A further series of three radiographs must be taken two weeks later If there is any fracture, it will show clearly after this interval*

Treatment —The wrist must be completely immobilized until there is radiographic evidence of union Every single shearing movement of the fragments retards the process of repair, and if the movement is repeated often enough the fracture will never unite A cock-up splint does not afford sufficient immobilization A plaster slab must be moulded to the limb from the metacarpal heads to the upper forearm, extending far enough round the radial and ulnar margins to prevent side-to side movements of the hand The wrist is in slight dorsiflexion and the thumb in opposition The plaster extends round the radial side of the index and thumb metacarpals, and must not fall short of these metacarpal heads The slab is then secured by encircling turns of plaster bandage which are very closely moulded in the palm of the hand so that wrist movement is completely limited The plaster must not extend beyond the skin creases of the palm

Fig 345 —Two-months -old fracture of the carpal scaphoid bone there is cavitation at the site of fracture

The patient must report at once if the plaster shows signs of cracking at the wrist, and he must not allow it to become wet With these reservations he may undertake any activity, and may even return to work

Duration of Immobilization.—Most fractures of the tubercle of the scaphoid are united in four weeks, and most recent fractures of the wrist in eight to ten weeks *If the fracture is not united at that time, strict immobilization must be continued until it is united* If occasional movements have been permitted, it may be necessary to continue for three or four months If there was delay in instituting immobilization, six to twelve months may be required If the fracture is near the proximal pole, repair is often slow, because the blood-supply of the proximal fragment is impaired, immobilization may be required for twelve to eighteen months If the surgeon is prepared to continue immobilization as long as each individual case requires it, bony union can be secured in every recent fracture of the scaphoid

Even if it is necessary to immobilize the wrist for from six to twelve months, the circulation and functional activity can be maintained so easily by finger movement that the joint does not stiffen Only when half of the scaphoid is deprived of blood, so that avascular necrosis supervenes, does any serious stiffness occur

DISLOCATION OF THE SEMILUNAR (LUNATE) BONE

Clinical Signs —The semilunar bone is dislocated forwards into the very confined space beneath the anterior annular ligament This space is already almost fully occupied by the flexor tendons of the fingers and the median nerve The typical clinical signs are, therefore, immobility of the semiflexed fingers, median paralysis in 50 per cent of cases, and swelling and painful limitation of wrist movement, with no obvious deformity

X-ray Diagnosis —The radiographic appearances are quite typical, but are often misinterpreted In the lateral view it is evident that the head of the os magnum no longer lies in the cup of the semilunar (*Fig* 346), but is displaced behind it As a rule the semilunar is tilted so that its cup is directed forwards instead of downwards This 90° tilt accounts for the different shape of the X ray shadow in the antero-posterior view (*Fig* 347) Whereas normally the bone outline is quadrilateral, when it is dislocated it appears triangular

Method of Reduction—Manipulative reduction is seldom difficult. The surgeon presses over the front of the semilunar with one thumb. With the other hand grasping the patient's fingers he applies strong traction to the remainder

Fig. 346—Dislocation of the carpal semilunar bone. In a lateral view the cup of the semilunar is tilted forwards and the os magnum lies behind it.

Fig. 347—The same showing the antero-posterior view. The normal quadrilateral shaped shadow of the lunate is now triangular.

of the carpus, pulling the os magnum away from the radius and gradually flexing the wrist so that the head of the os magnum is pulled into the cup of the semilunar (*Fig.* 348).

If the dislocation is of one, two, or three weeks' duration, sustained and prolonged traction may be necessary. An assistant takes the patient's thumb in one hand and the fingers in the other, and pulls steadily for five or ten minutes. After the traction has been maintained for some time, if the dislocation is not already reduced, the surgeon presses with both thumbs over the front lip of the semilunar and tilts it back into its socket. It is always difficult to be sure whether the dislocation is reduced or not, and a portable X ray machine should be used in the fracture theatre.

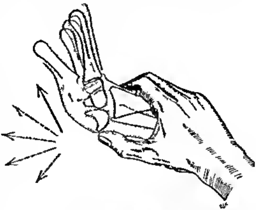

Fig. 348.—Manipulative reduction of dislocation of the semilunar.

After-treatment.—The wrist is immobilized by a dorsal plaster cast, in 45° of palmar flexion, for seven days. The plaster is then changed, no anæsthetic being used, and immobilization is continued with the wrist in the mid position for a further two weeks.

Dislocation of the Semilunar with Half of the Scaphoid.—Fracture of the waist of the scaphoid may be combined with dislocation of the semilunar, which carries the proximal half of the scaphoid with it. The distal half of the scaphoid remains attached to the os magnum and other carpal bones, and is displaced backwards and to the radial side. The dislocation is easily reduced in the usual way. The wrist is then immobilized for as many weeks or months as may be necessary to secure bony union of the fractured scaphoid.

Operative Treatment —Old unreduced dislocations of the semilunar, or of the semilunar and half scaphoid, should be treated by operative excision of the displaced bone Operative reduction is not advisable, because if the dislocation is of long standing the blood supply of the displaced bones is so impaired that avascular necrosis supervenes, with stiffness of the wrist

FRACTURES OF THE METACARPALS

The metacarpals may be fractured at the base, in the middle of the shaft, or at the neck There is usually no displacement, and the hand is simply immobilized for four weeks by a dorsal plaster cast similar to that used for fractures of the carpus The finger-joints must be left free for movement The old method of strapping the fingers over a roll of wool or bandage in the palm must not be used

If there is angulation of a fracture of the shaft or neck of the metacarpal, with displacement of the metacarpal head forwards into the palm, the displacement must be reduced This must not be attempted by hyperextension of the metacarpo phalangeal joint, because the manœuvre will fail, and immobilization of the fingers in this position causes permanent stiffness The metacarpo-phalangeal and proximal interphalangeal joints are flexed to the right angle, if the phalanx is then thrust backwards, the metacarpal head is pushed backwards and the angulation thereby corrected The finger is immobilized with both joints flexed 90°

BENNETT'S FRACTURE-DISLOCATION OF THE THUMB

In this injury a marginal fragment is broken off the base of the thumb metacarpal This fragment, however, remains in its normal position, and it is the metacarpal itself which is displaced The base of the metacarpal is partly or completely dislocated from the trapezium, and lies to the radial side of the carpus (*Fig* 349) If it is unreduced, abduction movement of the thumb is lost,

Fig 349 —Bennett's fracture-dislocation of the thumb metacarpal.

Fig 350 —Plaster cast with thumb traction for Bennett's fracture-dislocation.

the span is reduced, the thumb is greatly weakened, there is an ugly deformity, and arthritis of the carpo-metacarpal joint may supervene

The oblique articular surface of the trapezium coincides with the line of fracture and forms a sliding plane Reduction is therefore unstable and traction on the thumb is usually essential The dislocation is reduced by strong firm pressure over the prominent base of the metacarpal A dorsal plaster cast is applied closely moulded over the base of the metacarpal A strong wire loop is incorporated in the plaster and skin traction applied (*Fig* 350) The traction is maintained for two or three weeks and immobilization is continued for a total period of five weeks

INJURIES OF THE FINGERS

The finger joints are to be regarded as the most important joints in the upper limb, a workman with completely stiff fingers is very little better off than a workman with an amputated arm These joints are particularly susceptible to injury, they very readily stiffen, and even minor sprains may cause many months of incapacity Every finger injury must therefore be treated with great respect, and if serious and possibly permanent incapacity is to be avoided, certain principles of treatment must be observed —

1 *The injured finger must be immobilized for at least two or three weeks* This applies even to joint sprains

2 *The finger must be immobilized in the flexed position* This is the position in which reduction is usually most stable, it is the position in which the injured finger will stiffen least, and it is the only position which will allow bending movement of the other fingers If one finger is held fully extended it is quite impossible to bend the others

3 *Every finger except the injured one must be left free from splints, strapping, or bandage* There must be no impediment of any sort to full movements of the normal fingers

4 *The patient must move every uninjured finger throughout its normal range many times a day* It is not enough to 'waggle' the finger in the middle range of movement The limits of flexion and extension must be reached

5 *Passive stretching and manipulation must never be permitted* Massage is a waste of time, if the fingers are stiff, active exercise is the essential measure, if the fingers are swollen, elevation of the limb will relieve the swelling

Sprains of the Finger-joints —The joint is acutely painful and swollen Radiographs may show small bony chips detached from the joint margin by avulsion of the capsule In other cases the capsule itself is torn Many finger sprains have been actual dislocations, spontaneously reduced at the moment of injury The joint should be immobilized in moderate flexion for two or three weeks by a collodion gauze dressing Collodion is painted on the skin and ribbon gauze bandaged over it Four or five alternate layers of collodion and gauze complete the dressing, which dries to form a splint sufficiently rigid and less bulky than plaster Recovery after interphalangeal joint strains is sometimes slow, and it may be many months before the joint thickening has finally subsided and movement fully recovered

Dislocation of the Fingers —Dislocations are usually due to hyper-extension injuries A triangular fragment may be chipped from the base of the distal phalanx Reduction is easily accomplished by traction and flexion of the joint The finger is immobilized for three weeks by a small plaster cast with all joints flexed at least 30° to 40° Reduction is sometimes unstable, and check radiographs must be taken seven days after reduction If the detached fragment is a fairly large one and carries one third or more of the articular surface of the joint, there is a strong tendency to recurrence of the dislocation This injury is comparable with Bennett s fracture dislocation of the thumb, and should be treated in traction

Dislocation of the Thumb —Dislocations of the metacarpo phalangeal joint of the thumb are also produced by hyperextension, and are sometimes difficult to reduce because the tendons of the short thenar muscles slip round the sides of the metacarpal head The sesamoids may be interposed between the two articular surfaces If manipulative reduction fails, operative reposition is necessary

Operative Treatment—Old unreduced dislocations of the semilunar, or of the semilunar and half scaphoid, should be treated by operative excision of the displaced bone Operative reduction is not advisable, because if the dislocation is of long standing the blood supply of the displaced bones is so impaired that avascular necrosis supervenes, with stiffness of the wrist

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4 *The patient must move every uninjured finger throughout its normal range many times a day* It is not enough to 'waggle' the finger in the middle range of movement The limits of flexion and extension must be reached

5 *Passive stretching and manipulation must never be permitted* Massage is a waste of time, if the fingers are stiff, active exercise is the essential measure, if the fingers are swollen, elevation of the limb will relieve the swelling

Sprains of the Finger-joints—The joint is acutely painful and swollen Radiographs may show small bony chips detached from the joint margin by avulsion of the capsule In other cases the capsule itself is torn Many finger sprains have been actual dislocations, spontaneously reduced at the moment of injury The joint should be immobilized in moderate flexion for two or three weeks by a collodion-gauze dressing Collodion is painted on the skin and ribbon gauze bandaged over it Four or five alternate layers of collodion and gauze complete the dressing, which dries to form a splint sufficiently rigid and less bulky than plaster Recovery after interphalangeal joint strains is sometimes slow, and it may be many months before the joint thickening has finally subsided and movement fully recovered

Dislocation of the Fingers—Dislocations are usually due to hyper-extension injuries A triangular fragment may be chipped from the base of the distal phalanx Reduction is easily accomplished by traction and flexion of the joint The finger is immobilized for three weeks by a small plaster cast with all joints flexed at least 30° to 40° Reduction is sometimes unstable, and check radiographs must be taken seven days after reduction If the detached fragment is a fairly large one and carries one third or more of the articular surface of the joint, there is a strong tendency to recurrence of the dislocation This injury is comparable with Bennett's fracture-dislocation of the thumb, and should be treated in traction

Dislocation of the Thumb—Dislocations of the metacarpo-phalangeal joint of the thumb are also produced by hyperextension, and are sometimes difficult to reduce because the tendons of the short thenar muscles slip round the sides of the metacarpal head The sesamoids may be interposed between the two articular surfaces If manipulative reduction fails, operative reposition is necessary

Fracture of Phalanges.—These usually occur in the shaft of the bone. The proximal fragment is flexed and the distal fragment tilted backwards (forward angulation) The displacement is reduced by traction and flexion of the joints The digit is immobilized by a small plaster cast If the fracture is oblique and there is considerable overriding, traction may be necessary

Mallet Finger.—The extensor tendon is avulsed from the base of the terminal phalanx with or without a small flake of bone The terminal joint is flexed and although passive extension is possible, active extension is lost. Failing suitable treatment, a severe mallet-finger deformity develops The whole of the power of the extensor tendon is then concentrated on the proximal interphalangeal joint A hyperextension deformity at this joint is therefore added to the flexion deformity at the terminal joint The finger must be immobilized by a plaster cast for at least six weeks, with the proximal joints flexed and the terminal joint hyperextended

CHAPTER XLIV

FRACTURES AND DISLOCATIONS OF THE BONES OF THE FACE, SPINE, AND PELVIS

By R. Watson Jones

FRACTURES OF THE BONES OF THE FACE

Nasal Bones —The nasal bones or cartilages and the nasal septum may be fractured by direct violence, and even minor degrees of displacement cause serious disfigurement Asymmetry due to lateral displacement should be corrected by direct pressure over the fragments An instrument such as a pair of straight artery forceps covered with thin rubber tubing may be inserted into the nostril to correct lateral deviation of the septum and to elevate depressed fragments Reduction is usually stable, it is seldom necessary to use any splint, and the nose should not be plugged

Malar Bone —Fractures of the zygomatic arch and malar bone are usually depressed, if the fragments are not elevated facial disfigurement persists There is sometimes anæsthesia of the cheek and lip from compression of the infra-orbital nerve Replacement can be effected by an elevating instrument inserted through a half inch incision placed within the hair margin above and behind the zygomatic arch

FRACTURES AND DISLOCATIONS OF THE LOWER JAW

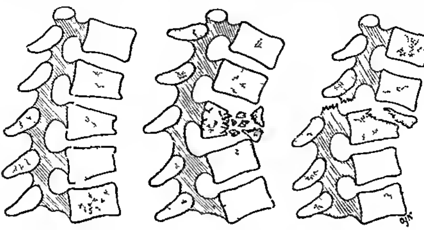
Fractures of the Lower Jaw —Almost every fracture of the body of the jaw is compound into the mouth, and frequent antiseptic mouth washes are necessary A fluid diet is prescribed, and soft foods may be taken after a week or ten days When there is no displacement of the fragments, the jaw is supported by means of a four tailed bandage for about ten days If the fragments are displaced and occlusion of the teeth is inaccurate, the co-operation of a dental surgeon should be sought After reduction of displacement, the jaw may be immobilized by (1) An interdental splint cemented on to the teeth, (2) Wires secured round the teeth which fix upper and lower jaws together, (3) Transfixion pins driven into each fragment and fixed to each other by a stainless steel or vitallium plate

Dislocation of the Lower Jaw.—This may be bilateral, when both condyles slip forward on to the articular eminences, or may be unilateral, when one condyle slips forwards and pushes the jaw and chin towards the opposite side To reduce the dislocation the operator stands in front of the patient, and, with his protected thumbs passed into the mouth, presses the angle of the jaw downwards, at the same time raising the chin with his fingers outside the mouth The jaw is supported by a four tailed bandage kept in position for two or three weeks, the patient meanwhile being fed on fluids and soft foods

FRACTURES OF THE SPINE

Types of Fractures (*Fig* 351) —There are three types of flexion fracture (1) Simple wedge compression of one or more vertebræ, (2) Comminuted fracture

of one vertebral body due to more localized and acute angulation, (3) Fracture dislocation



A B C

Fig 351 —Three types of crush fracture of the spine A Wedging of one or more vertebral bodies B Communited fracture of a vertebral body C Fracture-dislocation.

Diagnosis —The important clinical sign is abnormal prominence of one spinous process The deformity may not be obvious on inspection, but is easily felt when the examining finger passes down the line of spinous processes The patient usually, but not always complains of pain in the back Every patient who falls, even from a moderate height in the sitting or standing position, and has pain in the back, should be radiographed even if abnormal prominence of a spinous process cannot be detected

X ray Examination —The lateral radiograph discloses the injury more clearly than the antero posterior film Even the slightest wedging of a vertebral body must be accepted as a complete fracture

If the spine is not immobilized in hyperextension the wedging will steadily increase and a deformity develop This is the nature of the condition described as Kummell's disease If a crush fracture is suspected on clinical grounds but there is no evidence of it in the lateral radiograph, further films must be taken with the spine flexed If the diagnosis is still in doubt, the radiographic examination should be repeated two or three weeks later

Principles of Treatment —No fracture is more easily reduced than a fracture of the spine, but the omission of apparently trivial details may lead to failure Compression of the vertebral body is corrected by the tension of the anterior common ligament attached to its upper and lower margins The spine must therefore be immobilized in the position of hyperextension *It is not enough to extend the spine, reduction is perfect only if it is hyperextended to the normal limit* Unless there is actual tension on the anterior common ligament reduction will be imperfect, and wedging and redisplacement will recur

Method of Reduction and Immobilization —No anæsthetic should be used Morphine ¼ gr is given fifteen minutes before reduction is begun. The patient is rolled on to his face, so that when he is lifted, the spine will be extended and the dangerous movement of flexion avoided (see p 268) A double layer of stockinette 8 in wide is pulled over the trunk and fixed over the shoulders and

in the perineum Each anterior superior iliac spine is protected by adhesive felt, and a larger piece of felt, 4 × 6 in, applied over the spinous processes at the level of fracture Two tables, one ten or twelve inches higher than the other, are placed end to end, with a space between them slightly greater than the length of the patient's trunk The patient is then lifted into position so that his head and arms are resting on the edge of the higher table (*Fig* 352) The lower table supports the lower limbs to the

Fig 352 —Reduction and plaster fixation of a crush fracture of the lumbar spine The pelvis is entirely clear of the lower table and there is no ventral sling so that the lumbar spine is fully hyperextended

Fig 353 —An efficient plaster jacket extending from the clavicles to the symphysis pubis

level of the upper thigh, but must fall short of the symphysis pubis by several inches The pelvis must be entirely free of support so that it can tilt forwards, and the whole trunk must sag between the two tables There must be no sling or hammock to support the abdomen and chest

Plaster is at once applied, and successive layers are rubbed into each other firmly This degree of pressure is sufficient to complete the reduction, there must be no manipulation and no forcible thrusting over the kyphos The plaster must extend from the groin to the clavicles (*Fig* 353) A small area may be cut out in the midline between the two clavicles to prevent pressure on the larynx Sufficient plaster is also cut from the groins to permit flexion movement of the hips, and from below the axillæ to allow free movement of the arms A window must be cut over the spinous processes at the site of injury, this window should be slightly smaller than the piece of felt already applied, and the felt is not removed Only in this way can pressure sores be avoided

A common mistake is to carry the jacket anteriorly no higher than the nipple line If this is done it is still possible for the patient to flex the upper dorsal spine, and to transmit movement to the region of the fracture Unless the plaster is intact from the clavicles to the symphysis pubis, redisplacement will occur

After-treatment.—Until the plaster is thoroughly dry the patient lies with pillows beneath the concavity in the arch of the spine The position is then changed every few hours during the day, to avoid hypostasis and congestion of the lungs The patient may sit up at once, and if there is no nerve complication, walking may be resumed within a day or two Exercises are taught to maintain the tone of the spinal and abdominal musculature

Lying on the face with the arms by the side, the head and shoulders are slowly raised from the bed and lowered again Each hip is slowly hyperextended with the

knee straight, and as the patient becomes more expert, both hips are simultaneously hyperextended The patient should resume normal activities, wearing normal dress over the plaster jacket The victim of spinal injury understands that " his back is broken " and has difficulty in believing that complete recovery is possible Psychological disturbances and the tendency to exaggeration and malingering are minimized if normal activity is resumed at an early stage

It may be necessary to cut a window in the plaster over the upper part of the abdomen The elderly man with emphysema of the chest and calcification of the rib cartilages breathes mainly with the diaphragm and the abdominal wall If a rigid plaster is applied over the abdomen, there may be serious respiratory distress, which is promptly relieved by a window six to eight inches in diameter over the upper half of the abdomen. A window may also be necessary to relieve flatulence and abdominal distension It is not advisable, however, to cut such a window as a routine, because it may weaken the jacket

Duration of Immobilization—The plaster jacket usually becomes loose after two or three weeks, and a new jacket must then be applied, again with the spine in hyperextension The first degree of hyperflexion fracture, where there is simple wedge compression of one or more vertebral bodies, must be immobilized in plaster for four months If the jacket is discarded earlier, deformity will recur Comminuted fractures unite still more slowly, and six months of immobilization is necessary The third type, where there is a fracture-dislocation, should also be immobilized for four to six months

It is inadvisable to use a posterior spinal support after the plaster is discarded If the fracture is firmly united the support is obviously unnecessary, and if it is not firmly united the plaster has been discarded too early A spinal support will not prevent recurrence of deformity After removal of the plaster, movement of the spine is regained by the patient's own exercise It is seldom necessary to manipulate the spine, and full movements should be regained within about two months of discarding the jacket

FRACTURES AND DISLOCATIONS OF THE CERVICAL SPINE

Subluxation of Cervical Spine—Crush fractures of vertebral bodies seldom occur in the cervical region, but subluxation of one interarticular joint

Fig 354—Application of plaster for subluxations and fractures of the cervical spine The neck is hyperextended over a spinal rest made of wood nailed to a wooden table. Plaster is applied and the patient is then slid off the spinal rest.

is a frequent injury There is often pressure on the adjacent nerve-root causing pain, tingling, or numbness in one or both arms Immobilization by means of a plaster jacket is essential A piece of ½ in wood, 3 in wide, is nailed to a wooden

table so that it projects one foot from the end, and is padded with wool to form a rest The head is held by an assistant, with the cervical spine in full extension and neutral rotation (*Fig* 354) The arms are held in the abducted position, and plaster is applied from the crest of the ilium over the trunk, neck, and head The jaw and forehead must be included in the plaster so that flexion movement of the neck is prevented The patient's comfort is greatly increased by cutting a window over each ear Immobilization is continued for not less than two months

Fracture-dislocation of the Cervical Spine—The reduction and immobilization of fracture-dislocations usually calls for skeletal traction from the skull, but such treatment is beyond the scope of this work

SPINAL FRACTURES WITH PARAPLEGIA

Recoverable and Irrecoverable Paralysis—Fractures and fracture-dislocations of the cervical, dorsal, or lumbar regions may be associated with injury to the spinal cord and paralysis of the lower limbs, bladder, and rectum The cord injury may be a simple contusion, a compression by the bony walls of the spinal canal, or an actual severance of the nerve-fibres If the cord is severed, no recovery is possible whatever treatment is undertaken On the other hand, paraplegia due to simple compression will recover if the compression is relieved

Treatment.—During the first ten days the types cannot be distinguished by neurological tests In all cases, therefore, immediate steps should be taken to relieve pressure This can be done by reducing the fracture The spine must be hyperextended at once Complete anæsthesia below the level of the lesion makes it difficult to avoid decubitus sores, but with careful nursing, an ordinary hyperextension plaster jacket or plaster bed may be used

One of the most important considerations is the relief of retention of urine Before passing a catheter the house surgeon should consult the views of the surgeon in charge of the case Modern methods of coping with the paralysed bladder include tidal drainage, which necessitates complicated apparatus, but is very efficient Alternatively a de Pezzer catheter may be introduced into the bladder and connected to a St Mark's apparatus (p 238) There are few surgeons to-day who advocate repeated catheterization The patient should be given *urinary antiseptics at once, even before infection has developed*

Prognosis—The prognosis in fracture-dislocations of the upper dorsal region is poor, because the cord has usually been severed In cervical injuries the outlook is better, and in lumbar injuries which involve the medullated fibres of the cauda equina and not the cord itself, recovery from paralysis is possible in about 40 per cent of cases

FRACTURES AND DISLOCATIONS OF THE PELVIS

The bone injury is often unimportant, but the associated injury to soft tissues may be serious or even fatal Injuries to the urethra, the bladder, and the rectum must be excluded

Injuries to the Urethra or Bladder.—If injury to the urethra or bladder is even suspected, arrangements should be made immediately with the surgeon in charge of the case to carry out the necessary investigation in the operating theatre Sounding of the urethra and similar procedures should not be carried out except in an operating theatre where asepsis can be assured and if necessary operation undertaken immediately If urgent relief of retention of urine is needed before these facilities are at hand, catheterization is still contra-indicated, the bladder,

if full, should be emptied by suprapubic aspiration In cases of rupture of the urethra, the patient must not under any circumstances even attempt to pass urine

Injuries to the Rectum —These are rare, and are usually caused by a fracture of the coccyx In most cases nothing more than a slight laceration exists, but in more severe injuries extensive operations may be required

Treatment of the Bone Injury —The common injuries to the pelvis are fractures of one or both pubic rami, slight separations of the symphysis pubis, and fractures of the body of the ilium No special treatment is necessary other than recumbency for three or four weeks Fracture boards are placed beneath the mattress, and the pelvis is surrounded with a firm wide binder or a many tailed bandage No attempt need be made to secure complete immobilization, and there is no necessity for a plaster spica or plaster jacket As soon as the tenderness has subsided, the patient may sit up, and recovery should be complete within about two months

Disruption of the Pelvis —The one injury which requires special treatment is unilateral disruption of the pelvis, where there is a fracture in the anterior segment involving the pubis or pubic rami, and a second fracture or dislocation

Fig 355 —Three types of fracture-dislocation and disruption of the pelvis

in the postero-lateral segment involving the ilium or sacro-iliac joint (*Fig* 355) This injury follows compression of the pelvis in its antero-posterior axis One half of the pelvis is rotated outwards, carrying with it the corresponding lower limb Radiographs show wide displacement of the fragments of the pubis, but much less obvious displacement of the sacro-iliac joint

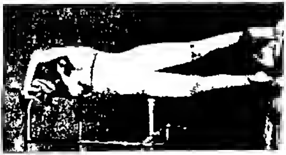


Fig 356 —Fracture-dislocation of the pelvis The dislocation is reduced and plaster applied in lateral recumbency

While the patient lies on his back, gravity and the weight of the lower limb maintain the outward rotation of the dislocated half of the pelvis A dislocated pelvis is like a partly opened oyster when laid on the hinge at the back, gravity

keeps the two halves apart, but when laid on one side the two halves close Similarly with the dislocated pelvis, if the patient lies on one side the two halves of the pelvis fall together

A plaster table or any form of pelvic rest is used with the perineal post removed The patient is placed on his uninjured side, with the trochanter lying on the pelvic rest and the two lower limbs held one above the other by an assistant Pressure may be applied over the crest of the dislocated ilium, pushing and rotating it downwards and forwards. Accuracy of reduction is confirmed by palpating the pubic bones through the lower abdominal wall and in the perineum

A radiograph should be taken before the plaster is applied The iliac crests are protected with adhesive felt, and a double plaster spica applied (*Fig* 356) The pelvic rest is cut out and the defect repaired

To prevent redisplacement within the plaster, the spica must be carefully moulded to the pelvis and trunk A new plaster is usually necessary in three or four weeks Immobilization is continued for ten weeks, and throughout this time the patient should lie on one side and not on the back

When the displacement is of minor degree, it may be necessary only to nurse the patient on his side on a firm mattress with fracture boards If the pelvic disruption is complicated by injuries to the bladder and urethra, simple lateral recumbency should be adopted at once A plaster spica freely cut away from the perineum and abdomen must be applied as soon as possible, because separation of the pubic bones interferes with repair of the bladder

CHAPTER XLV

FRACTURES AND DISLOCATIONS OF THE LOWER LIMB

By R WATSON JONES

DISLOCATION OF THE HIP-JOINT

UMATIC dislocation of the hip joint was at one time very rare, but is becoming easingly common as the result of head-on motor collisions

Method of Reduction—The object of the manipulative procedure is to the hip and rotate it so that the femoral head lies just below the acetabulum,

Fig 357—Reduction of a traumatic dislocation of the hip The femoral head is rotated to the neutral position and lifted into the acetabulum.

then to lift the head into the acetabulum Reduction is easily accomplished gentle manœuvring, forcible manipulation and vigorous traction are unessary and dangerous The anæsthetized patient is laid on blankets on the r so that the surgeon can more easily hold the limb An assistant kneels by patient and steadies the pelvis with both hands The surgeon stands over hip, and with both hip joint and knee joint flexed to a right angle, he slowly ites the limb from the position of deformity into neutral rotation, and then s it with firm steady traction (*Fig* 357) This simple procedure will usually uce all types of dislocation

If it fails the surgeon again applies traction to the flexed hip, and circum ts the limb through the position opposite to that of the deformity, into neutral

the hip is adducted and internally rotated, it is flexed, traction is applied, the hip is moved into abduction and external rotation, and then into the neutral position In the anterior dislocation where the hip is abducted and externally rotated, it is flexed, traction is applied, the hip is moved into adduction and internal rotation, and then brought down to the side of its fellow limb

It is obvious that the limb must not be moved too forcibly or too suddenly into the position opposite to that of the deformity, or the head of the femur will slide right past the acetabulum into the opposite type of dislocation

Marginal Fracture of the Acetabulum—Marginal fragments of the acetabulum which are displaced with the head of the femur are often replaced fairly accurately when the dislocation is reduced, but it is sometimes necessary to perform an operative reduction

Avascular Necrosis of the Femoral Head.—The blood-supply of the femoral head is carried almost entirely through vessels in the capsule of the joint The nutrient and periosteal vessels of the shaft extend no higher than the neck of the femur When the hip is dislocated the capsule is torn, the vessels are damaged, and the blood-supply of the head is endangered If the vessels are completely torn or thrombosed, avascular necrosis supervenes The articular cartilage undergoes degeneration, and a stiff, painful, arthritic hip results

Evidence that this complication will arise may be seen in radiographs taken about six weeks after injury If the head of the femur has no blood-supply, it cannot undergo disuse decalcification, so that the head remains dense whereas adjacent bones decalcify

After-treatment—The whole of the treatment of traumatic dislocation should be governed by the danger of avascular necrosis Further capsular injury must be avoided by very gentle manipulation, and by immobilization of the joint in a plaster spica for two months Although in many cases early movement would not redislocate the joint, it interferes with repair of the soft tissues and may cause further thrombosis of capsular vessels The patient must not resume weight-bearing earlier than from two to three months after injury

If the complication does arise, there must be no weight-bearing until revascularization is as complete as possible Active movement may be permitted after two months, but no weight should be borne within six months The only alternative is to perform an arthrodesis of the hip-joint two or three years after injury, when the arthritis has fully developed

FRACTURE OF THE NECK OF THE FEMUR

Every elderly patient who after slight injury to the hip complains of pain, or is found to lie with the limb in external rotation, must be assumed to have sustained a fracture of the femoral neck until antero-posterior and lateral radiographs prove otherwise

Fracture of the neck of the femur is sometimes a terminal event in the lives of old and fragile patients Hypostatic bronchopneumonia and bedsores, or even the simple shock and general disturbance, may cause death within a week or two In such cases the patient's condition is too frail for active treatment of the fracture It must be explained to the relatives that general measures are more important than local treatment, and although the fracture will fail to unite, the patient is encouraged to sit up in bed at once If he survives, weight-bearing is resumed with a bucket-topped calliper in two or three weeks With modern surgical developments the number of patients who are too ill or too feeble for active treatment of the fracture is increasingly small

Three types of fracture must be distinguished (1) Abduction cervical fractures, (2) Adduction cervical fractures, and (3) Basal fractures (intertrochanteric and pertrochanteric)

Abduction Cervical Fracture.—This is a high cervical or subcapital fracture with true impaction (*Fig* 358) The femoral shaft and neck are abducted

Fig 358—Abduction fracture of the neck of the right femur

in relation to the proximal fragment in the coxa valga position Moreover, the fracture lies in a relatively horizontal plane (*Fig* 359) It follows, therefore, that weight-bearing and muscle pull impact the fragments more closely and do not give rise to shearing stresses These fractures always unite by bone whether

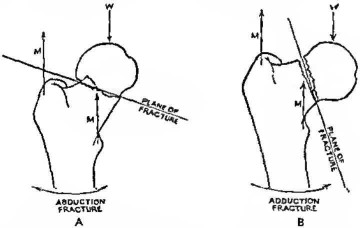


Fig 359—A In abduction injuries the fracture is in the relatively horizontal plane. Muscle retraction (M), and weight bearing (W) impact the fragments and bony union occurs spontaneously B In adduction fractures there is shearing stress from muscle retraction and weight bearing Non union occurs unless perfect immobility is secured by a nailing operation.

immobilized or not The only treatment necessary is rest in bed for about six weeks with a shoe and cross-piece to prevent rotation strain The knee-joint must not be allowed to stiffen, and even hip exercises are safe Recovery should be complete within about three months

Adduction Cervical Fracture—In this injury the distal fragment is adducted, the plane of fracture is relatively vertical, and the line of force of muscle pull and weight bearing is more or less parallel with the fractured surfaces so that there is shearing strain (*Fig* 360) Even if the fragments appear to be impacted, continued shearing strain prevents bony union, and there is progressive decalcification of the neck of the femur until it is entirely absorbed The displacement must be corrected, the fragments impacted in slight abduction, and

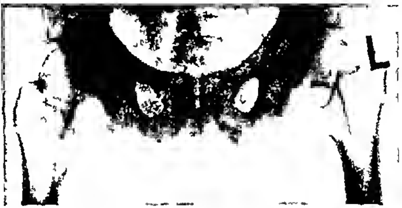


Fig 360—*Adduction fracture of the neck of the left femur*

immobilization maintained for many months Union is often slow, and may be unsound even after twelve months A plaster spica is therefore less satisfactory than a three flanged stainless steel nail driven through the neck of the femur into the head

After inserting the nail, a shoe is worn with a cross piece of wood nailed to the heel to prevent rotational strains (*see Fig* 321, p 271) The patient sits up at once and is encouraged to move freely in bed Knee exercises are practised from the first day, the patient must lie on one side, so that the knee-joint can be flexed fully without moving and straining the hip The arthritic knee-joint of an elderly patient lying flat in bed becomes stiff within a few days, and the pain and discomfort of movement during the first days after operation must be overcome by constant encouragement and stimulation

Weight bearing should not be resumed until from two to three months after operation If there is radiographic evidence of avascularity of the head, weight-bearing should be deferred still longer, in order to minimize the danger of avascular necrosis

Basal Fractures—If the fracture lies along the intertrochanteric line, it may still be possible to perform the nailing operation with complete success. If the fracture lies below the intertrochanteric line, the bone on the distal side of the fracture is too thin to afford a secure grip for the nail The hip must be immobilized for about four months in the position of full abduction and slight internal rotation The most satisfactory splint, especially in older patients who may develop bronchopneumonia, is the Roger Anderson 'well leg' traction apparatus (*see* p 324) The only alternative to this splint is an abduction frame or double plaster spica

DISPLACED UPPER FEMORAL EPIPHYSIS

This injury, like high fractures of the femoral neck, is liable to interfere with the blood supply of the femoral head Rough manipulations and open operations are therefore to be avoided In acute displacements of a few days' duration, reduction by gentle abduction and internal rotation of the limb and immobilization in a plaster spica or abduction frame is safe, but in long standing displacements even this degree of trauma may precipitate avascular necrosis and stiffness of the hip In such cases the deformity should be reduced gradually by traction Weight bearing should not be resumed until the epiphysial line has fused This usually involves at least six months of recumbency

FRACTURE OF THE SHAFT OF THE FEMUR

The essentials of treatment are to preserve full length, and to prevent rotation or angulation of the fragments, accurate apposition of the fragments is less important Since the muscles of the thigh are so long-bellied and powerful that there is a strong tendency to overriding and shortening, traction on the limb throughout the period of immobilization is essential

Fractures of the Middle Two-thirds —Fixed Traction Method —The best routine treatment of shaft fractures is immobilization in a Thomas knee splint with skin traction

General or local anæsthesia is used The foot and ankle are held by an assistant, who pulls strongly and steadily on the limb so that he can elevate it without damaging the soft tissues by the sharp bone fragments Three-inch wide brown holland strapping, warmed to make its surface adhesive, or " one-way stretch Elastoplast strapping ", is applied on each side of the limb from just above the malleoli to the level of the fracture The outer strip is centred a fraction behind the midline and the inner strip in front, so that the limb will lie slightly more in internal than in external rotation *The extension strapping must not be bound to the limb by circular or spiral turns of adhesive strapping, but by soft bandage* If strapping is applied in a spiral or circular manner, pressure sores will result in later weeks when it slides down the limb For the same reason the malleoli, ankle, and back of the heel must be protected by thick pads of wool under the extension tapes, and the encircling bandage must stop short two or three inches above the malleoli

The ring of the splint is then threaded over the limb, which is supported by means of slings between the side bars (*Fig* 361) A series of strips of flannel may be used, or preferably a wide metal gutter splint held in position by strong bandage slings placed at the top and bottom The normal forward curve of the lower shaft of the femur must be preserved by keeping two-thirds of the limb in front of the side bars and only one third behind, and by a pad of wool on the gutter splint just above the femoral condyles in the upper part of the popliteal space

To the lower free end of the extension strapping, strong linen tapes are secured by firm knots The outer tape is passed over the outer bar of the splint, the inner tape under the inner bar, the padded ring of the splint is pushed well up against the ischial tuberosity, and the extension tapes are tightened and fastened securely over the cross-bar at the end of the splint Added fixation for the fracture may be secured by a twisted aluminium gutter splint passing from the region of the trochanter to the front of the knee A final bandage is then applied, encircling the whole of the splints

AFTER-TREATMENT —As the traction continues, the extension tapes gradually slide down the limb and become slack, it is necessary to tighten them several times a day Moreover, the counter-pressure of the ring of the splint makes it

difficult to avoid pressure sores in the adductor region and groin Both these difficulties are easily met by the simple device of fastening the end of the splint to the foot of the bed, which is raised twelve inches The patient is then partly suspended from the foot of the bed by the extension tapes, so that the slightest degree of slack is at once taken up It is only necessary to tighten the tapes once

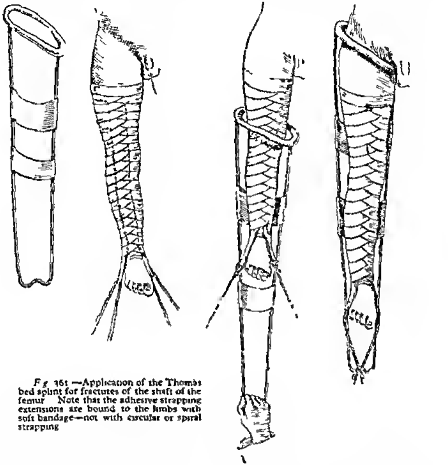


Fig 361 —Application of the Thomas bed splint for fractures of the shaft of the femur Note that the adhesive strapping extensions are bound to the limbs with soft bandage—not with circular or spiral strapping

a day or once every other day The patient tends to fall away from the ring of the splint and pressure in the groin is reduced The counter pull of the patient's body-weight increases the traction, and if the shortening is not fully reduced the traction is increased merely by raising the foot of the bed still more

The position of the fragments is confirmed radiographically, with a portable X-ray apparatus, every second or third week If full length and alinement is maintained by constant traction, the tension of the cylinder of muscles surrounding the fragments gradually corrects lateral displacement Throughout the period of immobilization the patient must practise toe and foot exercises, for five minutes every hour of the day the foot is dorsiflexed, inverted, everted, and circumducted After a few weeks the thigh muscles should be exercised by smooth rhythmic contraction and relaxation ('quadriceps drill')

After twelve weeks the degree of union is estimated clinically If the immobilization has been imperfect, or the fracture has been compound and infected, or for any other reason union is delayed, immobilization and traction in recumbency are continued for a longer period When the fracture is clinically firm, and is no longer tender, and the callus shown in the radiographs is calcifying, the Thomas splint is replaced by a calliper splint which is worn day and night Weight-bearing in the calliper splint is resumed when union of the fracture is consolidating A zinc-gelatine dressing is applied to the leg and a crêpe bandage over the knee to prevent recurrent œdema, if œdema is not prevented, the stiffness of the knee and ankle joints will be difficult to overcome The calliper is taken off three times a day for non weight bearing knee exercises It is finally discarded about six months after injury, when there is final consolidation of the fracture Weight bearing knee exercises are then practised from five to ten minutes hourly throughout the day The range of knee movement is measured every second week, the joint should not be manipulated under anæsthesia until it is found that movement is no longer recovering by the patient's own exercise

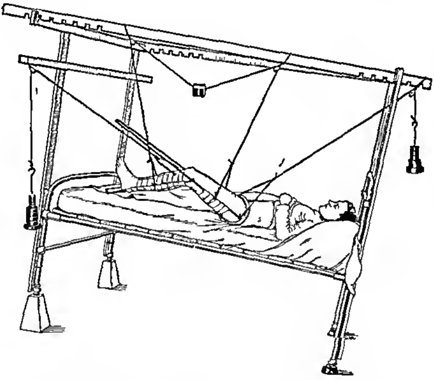


Fig 362—Balanced traction and suspension for fracture of the shaft of the femur The traction pin is in the tibial tuberosities—*not the femoral condyles* Great care is necessary to avoid overpull and distraction of the fragments

Fractures of the Middle Third: Balanced Weight-traction Method—If the fracture is several weeks old, or if for any other reason satisfactory reduction is not secured by the 'fixed' skin traction method, balanced weight-traction

may be used A Steinmann pin is driven through the tibial tubercle, and a stirrup fixed to the pin Infection of the pin track must be avoided, (*a*) by taking all aseptic precautions in the insertion of the pin, and (*b*) by fixing the pin securely so that it cannot rotate or move in its track through the bone A plaster bandage may be used, encircling the limb and incorporating the pin and stirrup A Thomas splint with a Pearson's flexed knee attachment is guided over the limb and suspended from an overhead beam with weights (*Fig* 362) A cord from the tibial pin stirrup passes over a pulley at the foot of the bed to a 20-lb weight The foot of the bed is raised on blocks The position of the fragments must be checked radiographically, and if necessary the weight may be increased

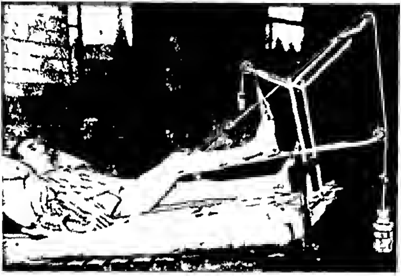


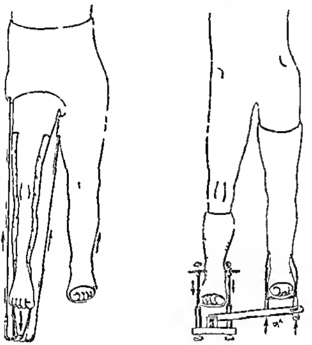
Fig 363 —Supracondylar fracture of the femur treated in the Böhler Braun splint with skeletal traction from a tibial pin The angle of the splint is above the level of the knee-joint The foot of the bed is raised about 18 in Light vertical traction on the foot prevents pressure sores behind the heel *A block of wood below the normal foot adds to the patient's comfort*

It is most important to avoid excessive weight and distraction of the fragments The slightest overpull, even if it causes no more than a third of an inch of distraction of the fractured surfaces, and even if corrected within a few days, adds many months to the necessary period of immobilization A fracture of the femur which would otherwise unite in two or three months, may then unite only after ten or twelve months Excessive traction is now the commonest cause of slow union of fractures Half an inch of shortening due to underpull is far less serious than half an inch of lengthening with slow union due to overpull

Fractures of the Lower Shaft—Supracondylar —At this level the small lower fragment is tilted backwards by the pull of the gastrocnemius muscle, especially if the tension on this muscle is increased by keeping the knee straight and the ankle dorsi flexed If this is not corrected, the fracture unites with backward angulation and genu recurvatum The knee must be flexed 45° and special care taken to support the back of the supracondylar region The fracture may be treated on a Braun's splint (modified by Böhler, *Fig* 363), with tibial skeletal traction The traction pin must be securely fixed by incorporating it in plaster From 10 to 15 lb weight extension is used The foot of the bed is raised 1 to 2 ft It must be raised enough to balance the traction weight on one side, and the patient's body-weight on the other The angle of the Braun's

splint lies just behind the supracondylar region—not behind the knee-joint—so that the fragments are supported and backward angulation is prevented Adhesive strapping is applied to the foot with slight vertical traction to prevent pressure sores behind the heel This technique often fails to correct the backward tilting, and it may be necessary to drive a second pin through the femoral condyles, so that the fragment can be pulled forwards After reduction the two pins are incorporated in a plaster spica This is better than using a Braun's splint and balanced traction, because a supracondylar pin which can twist and slide in its track may cause infection of the joint, infection of the fracture, or stiffness of the knee due to suprapatellar adhesions

Fractures of the Upper Shaft—Subtrochanteric—The small upper fragment is flexed, abducted, and slightly externally rotated by the muscles inserted into it. The alinement cannot be accurately controlled and the fragments cannot be adequately immobilized either in a Thomas splint or in a Braun's splint Even in a plaster spica



A B

Fig 364—The principle of "well leg" traction A Thomas's splint incorporated in plaster on the normal limb giving counter pressure against the sole of the normal foot. B The same principle used in the Roger Anderson splint

the fragments will redisplace unless continuous traction is maintained The Roger Anderson "well leg" splint is particularly suited to this injury It is especially useful in elderly patients, because the patient can sit up and the discomforts and dangers of a plaster spica are avoided. Whereas in a Thomas splint the traction is exerted from the fixed point of the side of the pelvis against which the ring of the splint presses, and in an abduction frame from the fixed point of the groin strap on the opposite side, in the "well leg traction" apparatus the traction is exerted from the fixed point of the sole of the opposite foot The idea was first evolved to overcome the difficulty of counter pressure on the skin of the groin The bars of a Thomas splint were incorporated in a plaster spica on the opposite side, so that the site of counter pressure was transferred from the groin to the sole of the opposite foot (*Fig* 364) The principle is equally effective if the upper half of the spica is omitted The normal limb is put in plaster

from the sole of the foot to the upper thigh, and the apparatus is incorporated in the plaster There will be upward pressure on this limb, so that the sole of the foot, the malleoli, and the neck of the fibula must be protected by pads of adhesive felt beneath the plaster On the injured side a pin is driven through the tibia one inch above the ankle-joint and incorporated in a short cast from the toes to the calf The splint is applied with the normal limb pushed up and the injured limb pulled down, so that although the limbs lie almost side by side, the normal hip is fully adducted and the injured hip fully abducted The traction is regulated by a screw mechanism just below the foot on the injured side, the greater the traction the more the hip is abducted, and the necessary degree is controlled by periodic radiographs The patient is encouraged to sit up at once so that the hip flexor muscles are relaxed, and at the same time hypostatic congestion of the lungs is avoided

Since the limbs are held firmly together by the 'cross bars of the pelvis at the upper end and the splint at the lower end, and are made rigid by the immobilization of one knee, the fragments cannot rotate or angulate despite turning of the patient from side to side, and despite movement of the pelvis as the patient sits up and down The tone of the muscles of both lower limbs is maintained by regular quadriceps drill and toe exercises

The splint is removed when the fracture is united in about ten weeks Regular exercises are then practised to restore knee movement, and weight bearing is resumed a few weeks later after consolidation of the fracture

Stiffness of the Knee-joint after Fracture of the Femur—Attempts have been made to avoid stiffness of the knee by permitting early movements of the joint after plating the fracture, or by encouraging movement while using supracondylar skeletal traction Very often the only effect of these measures has been to convert temporary stiffness into permanent stiffness The adhesions between the capsular plications of the joint and between the muscles of the thigh which result from immobility alone, are easily overcome within two to six months by the patient's own exercise Recovery is facilitated and accelerated by instituting regular quadriceps drill within a few weeks of fracture while the limb is still immobilized Only when immobility is complicated by such factors as are enumerated below does the stiffness resist the patient's exercises and often remain permanently

1 *Operative Reduction*—It is difficult to expose the shaft of the femur without some injury to the muscles of the thigh The muscles may become densely adherent to each other and to the fracture

2 *Supracondylar Skeletal Traction*—After a few weeks the pin track usually becomes the site of a low-grade infection causing serous exudation This is most common when the pin is allowed to rotate in its track, or when movable ice tongue callipers are employed If this serofibrinous exudation and infection does arise, the suprapatellar synovial pouch becomes densely adherent, and it is unlikely that the knee-joint will ever flex beyond 90°

There is no necessity to use supracondylar skeletal traction Traction from the tibial tubercle is equally effective and is safe, the criticism that tibial traction causes stretching of the ligaments of the knee is unfounded except in cases where excessive traction has been used

3 *Recurrent Œdema of the Knee*—If the knee is allowed to swell day by day, the adhesions which are daily soaked in serofibrinous exudation steadily increase in density, and permanent stiffness may result

4 *Early and Repeated Manipulation or Passive Stretching*—The tearing of adhesions by over vigorous methods produces fresh serofibrinous exudation and increases the adhesion formation The joint should not be manipulated until all swelling and œdema have subsided, until the circulation is restored, and until steady recovery of movement by the patient s own exercise has ceased

DISPLACED LOWER FEMORAL EPIPHYSIS

The epiphysis is usually displaced forwards in front of the lower end of the shaft, and tilted by the gastrocnemius muscle exactly as in supracondylar fractures To reduce the displacement the knee joint is flexed to a right angle, the head of the tibia is pulled away from the femur, and the epiphysis is pulled back to its normal position by traction on the leg The limb is immobilized by an anterior plaster cast with the knee flexed about 130° Pressure on the popliteal

vessels and nerves by tight bandage or plaster, or by acute flexion of the swollen knee, must be avoided Immobilization is continued for six weeks, and movement of the knee joint is then restored by the child's own active exercise

RUPTURE OF THE EXTENSOR APPARATUS OF THE KNEE

Avulsion of the Quadriceps—The radiograph shows no bone change, and for this reason the injury is sometimes overlooked Loss of active extension against gravity with tenderness at the upper margin of the patella in elderly patients is sufficient to establish the diagnosis It is usually possible to feel the gap between the muscle and the bone If the quadriceps is not stitched back, ossification occurs in the hæmatoma between the retracted muscle and the patella, giving rise to the condition described as "myositis ossificans of the quadriceps". The muscle should be firmly stitched with catgut mattress sutures As a rule, no external splintage is necessary, active flexion movements may begin at once and weight bearing exercises are resumed in a few weeks A full range of movement should be regained within four to six months

Fracture of the Patella with Displacement—When the patella is fractured by muscular action it must be recognized that the fracture is only a part of the rupture of the extensor tendon, there is also a rupture of the quadriceps expansion on each side of the bone The upper fragment is retracted by the quadriceps muscle, and the aponeurosis from the front of the patella falls inwards over the fractured surfaces Unless operative treatment is carried out fibrous union results, and because there is a gap between the patellar fragments with lengthening of the quadriceps tendon, full active extension is permanently lost

The skin must be carefully prepared for 36 hours If there are skin abrasions which might be infected, operation should be deferred After operation a plaster cast is applied with the knee almost fully extended Weight-bearing may be resumed within a few days The plaster cast is removed after eight or ten weeks, when the tendon is firmly repaired and the patellar fracture is united Flexion movement of the knee is regained by active exercises practised for a few minutes hourly throughout the day

Excision of the Fractured Patella—Since the patella is a sesamoid bone within a tendon, the removal of one fragment or even of the whole bone causes no disability In comminuted fractures with serious damage to the articular surface the bone fragments should be excised before the quadriceps tendon is repaired. Active knee movements are begun within a week or two, and weight bearing may be resumed within five or six weeks Recovery is therefore more rapid than after suture of the bone

Avulsion of the Ligamentum Patellæ.—The ligament must be stitched back to the bone Since the injury occurs in younger patients, there is no danger of permanent stiffness of the knee It is therefore quite safe to immobilize the joint in extension by a plaster cast for eight weeks

Avulsion of the Epiphysis of the Tibial Tubercle—After minor injuries the degree of separation of the epiphysis is minimal and may not be obvious in the radiograph, this is the condition known as Schlatter's disease The knee should be immobilized in plaster in the position of full extension for eight weeks When the displacement is more marked, the epiphysis must be replaced by manipulation or operation. The fragment is firmly pressed back to the tibia and the knee is immobilized in a closely fitting plaster cast for eight weeks

Fracture of the Patella without Displacement—Crack fractures may occur from a direct blow over the bone The fracture may lie transversely, or one of the angles of the patella may be separated by an oblique crack This injury is quite different from the other type of patellar fracture, in this case there is no rupture of the quadriceps expansion *Operative treatment is unnecessary* It may be advisable to immobilize the knee by a posterior plaster slab for a few weeks After a more severe contusion the whole bone may be comminuted and crushed, and excision of the patella is often advisable

DISLOCATION AND ALLIED INJURIES OF THE KNEE-JOINT

Traumatic Dislocation of the Knee—The lateral and crucial ligaments are torn or severely stretched, and the head of the tibia is displaced backwards, forwards, or laterally Manipulative reduction usually offers no difficulty The joint must be immobilized in a plaster cast from the toes to the groin for not less than ten weeks Ultimate recovery depends on the tone of the thigh muscles Even if the ligaments remain lax, if muscle control is perfect there will be little or no disability No trace of wasting of the muscles must be permitted, and from the first day after reduction quadriceps drill is practised for five minutes hourly Weight bearing may be resumed within a few days After the plaster is removed it is inadvisable to use a knee cage because it encourages wasting of the quadriceps Muscle redevelopment is still the *most important treatment*

Rupture of the Internal Ligament of the Knee—Minor sprains of the internal lateral ligament are treated by regular quadriceps drill, strapping of the joint until the effusion has subsided, and raising the inner border of the heel and sole of the shoe $\frac{1}{4}$ in to prevent valgus strains of the knee *Standing or walking in bare feet or in uncorrected shoes is not permitted for at least six weeks* Recovery may be accelerated by injecting 5 to 10 c c of 1 per cent novocain into the tender part of the ligament

When rupture of the ligament is complete and there is marked lateral instability of the knee, treatment should be carried out as for dislocation of the knee-joint

Rupture of One or Both Crucial Ligaments—This should also be treated as for dislocation of the knee-joint *Maintenance of normal volume* and tone of the quadriceps muscles is imperative

Fracture of the Tibial Spine—A severe rotation strain of the knee through the tension of the anterior crucial ligament may avulse the tibial spine from the head of the tibia The small fragment of bone is tilted forwards and outwards by the crucial ligament and external semilunar cartilage which remain attached to it There is then a bony block to the terminal 20° of extension of the joint *The fragment must be replaced by open operation* and the knee immobilized by a posterior plaster slab for six weeks Quadriceps exercise is practised throughout, and weight-bearing is permitted after a few days

FRACTURE OF THE TIBIAL TUBEROSITY

A severe abduction strain of the knee may not only rupture the internal lateral ligament, but also crush the outer tuberosity of the tibia As a rule the *tuberosity is split* vertically by the impact of the outer margin of the external femoral condyle (*Fig* 365) A lateral marginal fragment is displaced outwards, and the tuberosity itself is comminuted and depressed *The displacement must be reduced* to correct the knock knee deformity and to restore the smoothest possible articular surface While strong traction is applied in the long axis of the limb, the tibial tuberosities are laterally compressed either manually or

by a compression clamp The knee is held in as much varus as possible, and a closely fitting plaster cast is applied from the toes to the groin The ligamentous rupture is no less important than the bone injury Regular quadriceps exercise must be instituted at once, and the immobilization continued for not less than ten weeks Usually a new cast is necessary in four to six weeks, after the swelling has subsided, before weight bearing is resumed The inner border of the heel and sole of the shoe is raised ¼ in, and the patient is not allowed to stand or walk except in the corrected shoe for several months Development of the quadriceps muscle must continue throughout every stage of the treatment

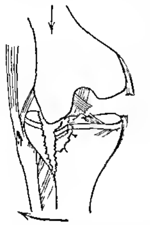


Fig 365 —Comminuted fracture of the external tuberosity of the tibia due to severe valgus strain The crucial and internal lateral ligaments are ruptured

FRACTURES OF THE SHAFTS OF THE LEG BONES

Fractures without Overriding —Greenstick and subperiosteal crack fractures of the shafts of the tibia and fibula occur fairly commonly in children Similar fractures may occur in adults where there is no serious loss of apposition but merely slight angulation of the fragments A plaster cast is applied with the limb hanging over the end of a table in the line of gravity Angulation and rotatory displacement are corrected When the plaster from the toes to the tubercle of the tibia is hard, the knee is almost fully extended and the cast is continued to the groin

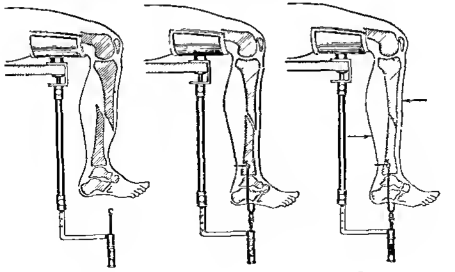


Fig 366 —Watson Jones tibia traction apparatus A Before reduction B After applying traction C, Traction and lateral pressure combined

Fractures with Overriding —When the fractures are complete and the fragments are disengaged, simple manual reduction is more difficult Some form of tibia traction apparatus should be used (*Fig* 366) A pin is driven through the tibia about 1 in above the ankle-joint, a stirrup is fitted to the pin, and screw traction employed until full length is restored and the fragments are in apposition The position is checked by radiographs taken with a portable apparatus, and a cast is applied from the toes to the knee (*Fig* 367) When it is hard, the plaster is extended to the groin with the knee slightly flexed Care must be taken that rotation displacement is completely corrected, so that the toes and patella point in the same direction

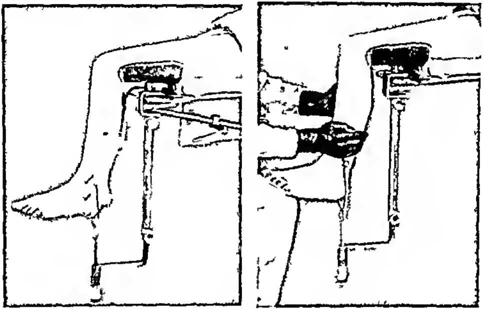


Fig 367 —Application of plaster for fractures of the shafts of the leg bones

Wedging the Plaster —Radiographs must be taken through the plaster, and if there is the slightest angulation of the fragments this is corrected by wedging A linear cut is made round two thirds of the plaster at the level of the fracture on the concave side of the angle A very short gas anæsthetic may be given, the linear division is opened to a wedge and a small block of wood placed between the two cut edges (*Fig* 368) The block of wood must be exactly opposite the angle—in front of the leg for backward angulation, on the inner side for outward angulation, half way between the two for combined backward and outward angulation, and so on Another radiograph is taken and the degree of correction may be increased or decreased by inserting larger or smaller blocks of wood When the alinement is quite perfect the gap in the plaster is filled and reinforced The wedging method allows absolute control and accurate correction of minor degrees of angulation *Caution is necessary when more severe angulation is corrected* Gross wedging may so increase the pressure of the plaster on the limb even a considerable distance above and below the level of the wedge, that pressure sores may develop unless this possibility is borne in mind and discomfort relieved by cutting windows

After treatment —If the toes are swollen the limb is kept elevated Regular toe exercises, especially flexion at the metatarso phalangeal joints, must be practised to prevent rigid hyperextension contracture and rigid transverse flat foot If the limb was already swollen when the plaster was applied, a new cast is necessary

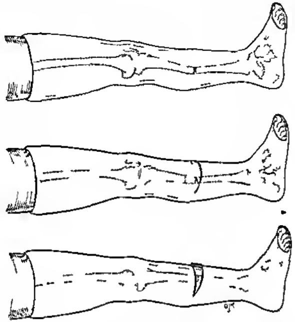


Fig 368 —Angulation of fragments corrected by wedging the plaster

three weeks later In all cases check radiographs should be taken three weeks and six weeks after reduction, because there is frequently a tendency to redisplacement within the plaster

After ten weeks the union may be tested clinically If there is tenderness over the fracture and elasticity or pain when the fracture is strained, a new cast is applied, again from the toes to the groin As a rule, at this stage weight bearing is safe A pad of Sorbo rubber is fixed to the heel and the foot of the plaster is covered with a cloth boot or galosh Union is tested at four weekly intervals and immobilization is continued by walking plasters until union is firm Occasionally it is necessary to continue immobilization for several months

When the plaster is removed a Viscopaste or Unna's paste dressing is at once applied to prevent recurring œdema Active exercises are practised for the knee- and ankle joints Very rarely a gentle manipulation of the ankle is necessary to relieve adhesion formation

Oblique Fractures with Overriding —When the line of fracture is oblique or spiral, the fragments are relatively unstable, and there may be a tendency to redisplacement In such cases continuous skeletal traction is often advisable for the first five or six weeks The fracture is reduced by the tibia traction apparatus and plaster is applied from the toes to the lower thigh The traction pin is not withdrawn, but is incorporated in the plaster, and a stirrup is attached, the limb is supported in a Braun s splint, and about 5 lb weight extension is maintained

(*Fig* 369) *The greatest care must be taken to avoid excessive traction* Distraction of the fragments even for a few days usually delays union for many months

When it is intended to leave the traction pin in the bone for several weeks, it should be driven through the lower shaft of the tibia 1 in above the ankle-joint,

Fig 369 —Skeletal traction for overriding fractures of leg bones Since the traction must be continued for several weeks the pin is driven through the shaft of the tibia and not through the os calcis Distraction of the fragments due to overpull must be rigidly avoided

and not through the os calcis If a traction pin is left in the os calcis, the sero-fibrinous exudation, which will probably develop along the pin track, binds down the subastragaloid synovial and capsular reflections, and may cause permanent stiffness of this joint After six weeks, when the fracture is beginning to unite, a new unpadded plaster is applied, the traction pin is withdrawn, and treatment is continued as for horizontal fractures

SPRAINS OF THE ANKLE AND DISLOCATION OF THE ANKLE-JOINT

The layman often asserts that it is worse to sprain an ankle than to fracture it If all ankle sprains are treated by simple strapping and early weight bearing this contention is true, for a certain proportion of ankle 'sprains' which show no bone injury in ordinary radiographs are actually dislocations of the joint Two types of injury to the external lateral ligament of the ankle must be distinguished

A simple sprain is a tearing of a few fibres of the ligament by inversion strains There is swelling, œdema, and ecchymosis below the external malleolus, pain on *inversion* movement, but no instability of the joint This is a relatively minor injury, and if adhesion formation is prevented, recovery should be completed within a few weeks On the other hand, the anterior and middle bands of the external lateral ligament may be completely ruptured The swelling, œdema,

and ecchymosis below the external malleolus are still more severe, and the ligamentous injury is now so complete that on inversion movement of the foot the astragalus tilts within the joint, and there is obviously excessive mobility Ordinary antero-posterior and lateral radiographs show no abnormality, but radiographs taken with the foot in maximum inversion show that the astragalus is subluxated, or even dislocated within the tibio fibular mortice Unless the joint is completely immobilized in plaster for at least ten weeks, recurrent dislocation is inevitable When the patient walks over rough, irregular surfaces, and the foot is suddenly inverted, there is no ligamentous protection, the astragalus again dislocates, the ankle gives way, and the patient may even fall to the ground

Sprain of the External Ligament of the Ankle—If the ankle is already swollen, the limb is firmly bandaged over wool and elevated until the swelling has subsided The foot and lower leg are then strapped with Elastoplast or brown holland strapping, applied from the inner side of the sole of the foot, across the outer side of the joint on to the leg, so that the ankle tends to be everted Non weight bearing exercises are practised at once, but only within the limit of pain After a few days weight bearing should be resumed The strapping is retained for at least two to three weeks If there is still swelling or œdema, an elastic anklet must be worn Recurrent œdema aggravates the tendency to adhesion formation, and must be prevented by elastic support and active exercise

If after two or three months there is still pain below the external malleolus on plantar flexion and inversion movement, and the radiograph shows no evidence of subluxation or dislocation of the astragalus on inversion, it is evident that adhesions have formed The joint should be manipulated under anæsthesia, and the patient must practise regular active exercise until recovery is complete

Complete Rupture of the External Ligament of the Ankle (Dislocation of the Ankle-joint)—A plaster cast must be applied from the toes to just below the knee, with the heel slightly everted No anæsthetic is necessary If there is already severe swelling, a new plaster is necessary in two to three weeks Weight-bearing in the plaster may be resumed at once The plaster is retained for ten weeks, and if clinical examination shows normal stability of the joint, weight bearing is then permitted with a Viscopaste dressing which is worn until the tendency to œdema has subsided If there is still instability of the ankle, shown by rocking of the astragalus on inversion movement, or by subluxation of the bone shown in radiographs taken in maximum inversion; an outside crooked elongated heel should be worn for several months, or even if necessary an inside iron and outside T-strap

If, through failure to recognize this condition, or through inadequate treatment, recurrent dislocation is allowed to occur, new ligaments must be constructed from free fascial grafts or from the peroneus brevis tendon

FRACTURES AND FRACTURE-DISLOCATIONS OF THE ANKLE

Varieties—Three types of malleolar fracture must be distinguished (1) Abduction and external rotation fractures, (2) Adduction fractures, and (3) Fractures due to vertical compression

1 In the first type of injury the foot is forcibly everted (abducted) or it is externally rotated in relation to the leg An abduction injury produces a horizontal fracture at any level of the external malleolus or shaft of the fibula, external rotation injuries produce spiral fractures of the external malleolus at the level of the tibio fibular joint This distinction between abduction and external rotation

fractures is, however, of little practical importance, both are treated in the same way, and they may be grouped together as the Pott-Dupuytren type There are three degrees of displacement (*Fig* 370) Relatively minor force results in a subperiosteal fracture of the external malleolus without displacement If the

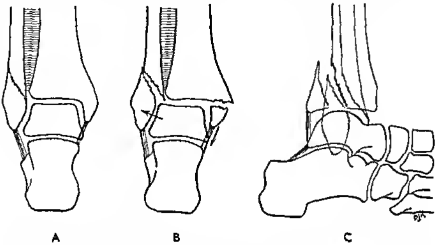


Fig 370—Abduction external rotation fractures of the ankle A 1st degree—fracture of the external malleolus without displacement. B 2nd degree—fracture of both malleoli with outward dislocation C 3rd degree—fracture of both malleoli and the posterior margin of the tibia with outward and backward dislocation

injury is more severe, the internal lateral ligament or a fragment of the internal malleolus is avulsed from the tibia, and there is outward displacement of the astragalus and foot In the third degree there is not only fracture of both malleoli with outward dislocation, but also fracture of the posterior margin of the tibia with backward dislocation

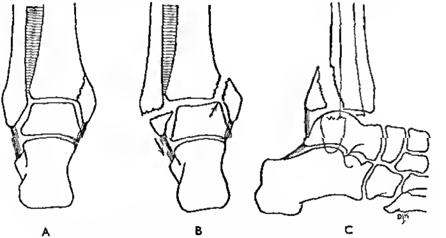


Fig 371—Adduction fractures of the ankle A, 1st degree—fracture of the internal malleolus without displacement. B 2nd degree—fracture of both malleoli with inward dislocation C 3rd degree—fracture of both malleoli and the posterior margin of the tibia with inward and backward dislocation.

2 Adduction fractures are due to forcible inversion of the foot, which drives the astragalus against the internal malleolus There are again three degrees of displacement (*Fig* 371) The least serious injury is the subperiosteal fracture of the internal malleolus without displacement This fracture is easily distinguished radiographically from avulsion injury of the internal malleolus due to abduction The abduction injury avulses a relatively small flake The adduction injury compresses the malleolus at its base, and the line of fracture runs almost vertically upwards from the inner angle of the ankle joint If the injury is more severe, the external lateral ligament, or a fragment from the external malleolus, is avulsed and the foot is dislocated inwards Still more gross violence causes fracture of both malleoli, and of the posterior margin of the lower end of the tibia, with inward and backward dislocation of the foot

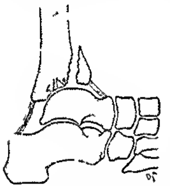


Fig 372 —Anterior marginal fracture of the ankle with forward dislocation

3 The third type is usually due to a fall from a height, so that the foot is driven forwards and upwards There is an anterior marginal fracture of the tibia and forward dislocation of the ankle-joint (*Fig* 372) Sometimes the lower end of the tibia and both malleoli are extensively comminuted

Fracture of the External Malleolus without Displacement—There is tenderness, œdema, and occasionally slight ecchymosis over the external malleolus, and the radiographs show a subperiosteal crack fracture without displacement If there is no injury on the inner side of the joint, plaster immobilization is not essential, and it may suffice to strap the foot, ankle, and lower leg with Elastoplast or brown holland strapping The surgeon must, however, be entirely satisfied that he has excluded not only actual displacement but also potential displacement If he is in any doubt it is better to apply a walking plaster

Fracture of the External Malleolus with Avulsion of the Internal Ligament—In this injury there is an actual or potential outward dislocation of the foot Even if there is no evidence of outward dislocation in the initial radiograph, if further radiographs taken in maximum eversion show that the astragalus displaces outwards, plaster immobilization for ten weeks is essential With the limb hanging over the end of a table, an unpadded plaster cast is applied from the toes to just below the knee, with the foot at right angles to the leg, and neutral to inversion and eversion (*Fig* 373, A) Whilst the plaster is hardening, the surgeon supports the forefoot with his knee to keep it at right angles to the leg, and he uses both hands to push the astragalus inwards as far as possible towards the internal malleolus In the case of a fracture of the left ankle, his left hand is placed over the lower shin, and his right hand over the outer side of the ankle and heel (*Fig* 373, B) Firm steady inward pressure is applied over the malleolus itself, it is usually quite impossible to over reduce No attempt should be made to maintain the position by twisting the foot inwards, adducting the forefoot, and inverting the heel, all the force will be expended on the tarsal joints

Fracture of the Malleoli with Outward and Backward Dislocation.—This is again reduced by direct pressure over the malleoli and heel, and not

indirectly by twisting the forefoot The limb hangs over the end of the table so that the knee is flexed and the calf muscles relaxed For a fracture dislocation of the right ankle the surgeon places his right hand over the front inner aspect of the lower shin, and his left hand over the outer aspect of the ankle, with his fingers curved round the back of the heel The foot is pulled strongly forwards and pressed strongly inwards An assistant steadies the foot by holding the toes while the plaster cast is applied This must be done as quickly as possible, and before the plaster has begun to harden the surgeon again takes the same grip and holds it strongly and firmly until the plaster has set When there is a posterior marginal fracture of the tibia, reduction is often unstable, and backward dislocation may recur while the plaster is hardening It is usually impossible to over-reduce, however strong the pressure which is applied

A B C

Fig 373—Reduction and plaster fixation of abduction fracture dislocation of the ankle A Application of the plaster B While the plaster is hardening the forefoot is supported by the surgeon s knee and the astragalus is pushed strongly inwards C, The transverse arch must be moulded up and the metatarso-phalangeal joints flexed Note the sorbo heel in position before the final turns of plaster are applied

Accuracy of reduction must be confirmed radiographically If the astragalus is even slightly tilted or displaced outwards, or there is the least trace of backward displacement, the plaster must be removed and a new cast applied Reduction and immobilization should be carried out as soon as possible after injury If the limb is already swollen, a new unpadded plaster is necessary in two to three weeks If the swelling is extreme, redislocation within the plaster as the swelling subsides is inevitable In such a case it is better to bandage the foot and leg firmly over wool, support it in a Braun's splint, elevate the foot of the bed eighteen inches for 36 to 48 hours, and then reduce the displacement and immobilize in plaster

After treatment—Immobilization for at least ten weeks is essential If the plaster is removed earlier, displacement will recur Check radiographs are taken during the third and sixth weeks With a Sorbo rubber heel and a plaster boot the patient is encouraged to walk If the limb was already swollen at the time of reduction, weight-bearing is deferred until the new cast is applied after two to three weeks During the last six weeks the patient should walk about five miles a day After ten weeks the plaster is removed and radiographs are

taken in the oblique axis to determine the degree of union of the external malleolus If the patient is heavy and the firmness of union is doubtful, plaster immobilization should be continued for a few weeks longer This is preferable to the use of an inside crooked heel, or outside iron and inside T-strap

As soon as the plaster is removed a zinc-gelatine dressing is applied to prevent œdema Protection is usually necessary for six weeks If there is still a tendency to recurring œdema, an elastic stocking is worn Exercises are practised to regain full movements of the ankle and tarsal joints Manipulation for adhesions is rarely necessary

Adduction Fractures and Fracture-dislocations—The principles of treatment are exactly the same as in abduction fractures and fracture-dislocations Fractures with actual or potential inward dislocation, or with inward and backward dislocation, must be immobilized in plaster for ten weeks The astragalus is replaced by strong outward pressure applied over the internal malleolus and inner side of the heel. Imperfect reduction is often seen, surgeons are so often impressed by the fallacy that because the everted position of the foot is a position of weakness, the inverted position must be one of strength, that they hesitate to push the heel outwards strongly enough. If the astragalus is allowed to remain tilted either outwards or inwards, there will be persistent pain and ultimately arthritis of the joint The only position of strength is the normal position, and this is attained in adduction fractures only by very strong outward pressure on the heel (*Fig* 374) It is practically impossible to over reduce

FIG 374—Reduction of an adduction fracture-dislocation of the ankle While the plaster hardens the astragalus is pushed strongly outwards

Anterior Marginal Fractures with Forward Dislocation—A large fragment is broken off the front of the lower end of the tibia, and displaced with the astragalus and other tarsal bones forwards and upwards The more the foot is dorsiflexed the more it dislocates forwards It must be reduced by pushing the tarsus backwards and downwards, and immobilized in plaster with the foot in moderate plantar flexion Reduction is usually so unstable that skeletal traction is necessary for the first four to six weeks A traction pin through the os calcis is incorporated in the plaster The limb is supported in a Braun's splint and 10 lb weight extension used in a backward as well as a downward axis

If the displacement is not perfectly reduced, osteo-arthritis of the ankle-joint supervenes and an arthrodesis is necessary Sometimes the articular surfaces of the joint are so comminuted and fragmented that osteo-arthritis is inevitable even despite accurate reduction In such cases an early arthrodesis is advisable,

DISPLACED LOWER EPIPHYSIS OF THE TIBIA

Abduction strains of the ankle-joint in children may cause outward displacement of the lower tibial epiphysis Reduction, immobilization in plaster, and after treatment are carried out as for abduction fractures in adults Adduction fractures may also occur, and these are more serious because the inner half of the lower tibial epiphysis is crushed and its growth is therefore arrested The outer half of the epiphysis and the lower fibular epiphysis continue to grow and gradually

force the foot into the inverted position The deformity must be corrected by osteotomy, or prevented by operative fusion of the undamaged part of the epiphysial lines

FRACTURES OF THE ASTRAGALUS (TALUS)

Fracture of the Neck of the Astragalus is of importance because the true nature of the injury is so often overlooked Unless radiographs are examined with great care the injury appears to be a simple fracture without displacement, whereas in fact there is almost invariably a dislocation of the posterior half of the subastragaloid joint, and unless this is corrected, painful stiffness of the foot persists as a serious permanent disability The clue to the displacement lies in the fact that when the body of the astragalus is separated by fracture from the other tarsal bones, it always tilts into the plantar-flexed (equinus) position If the foot is not held in a similar degree of equinus, but is immobilized in the usual right-angled position, there is no normal apposition between the body of the astragalus and the head of the bone in front, nor the os calcis beneath The foot must be fully plantar-flexed (neutral to inversion and eversion), and immobilized in plaster in this position for six or eight weeks After that time, when the fracture is uniting, a new walking plaster is applied in as much dorsiflexion as can be secured without straining the site of fracture Two or three weeks later a third plaster is applied with the foot in the right-angled position This is discarded after several weeks

FRACTURES OF THE OS CALCIS

The weight of a patient falling from a height on to his heels frequently crushes one os calcis or both The bone is spread laterally, so that the heel feels unduly broadened The subastragaloid joint is usually involved, causing pain and limitation of inversion or eversion movement of the heel The back of the os calcis is displaced upwards If this remains uncorrected, the power of the calf muscles is reduced by the relaxation of the tendo Achillis

Accurate reduction is possible only by skeletal traction from a pin driven through the back of the os calcis An ordinary tibia traction apparatus may be used (*see Fig 366*) The lateral spreading must be reduced by strong compression between the surgeon's two hands, or by a Thomas' wrench or special clamp (Böhler's compression clamp) A cast is applied, the plaster is well moulded on each side of the os calcis, and the traction pin is incorporated in the cast, redisplacement will occur unless continuous traction is used for ten weeks (*see Fig* 369) The limb is supported in a Braun's splint and 10 lb weight traction used The subastragaloid joint is so damaged by the fracture that movement will be permanently limited, and the usual objection to continuous os calcis traction (*see* p 331) is less forcible than in fractures of the leg bones If the articular surfaces are seriously fragmented and comminuted, arthrodesis of the subastragaloid and mid tarsal joints is advisable about three months after injury

FRACTURES OF THE METATARSALS

The shafts of the metatarsals may be fractured by a direct crushing injury, or indirectly by twisting strains sometimes sustained almost spontaneously after strenuous marching The base of the 5th metatarsal may be fractured by the pull of the peroneus brevis tendon during a sudden inversion strain of the foot If these fractures are not immobilized in plaster, union is delayed, callus may

be excessive, and the disability period is prolonged An unpadded plaster cast in which the patient may walk at once should be retained for six weeks Recurrent œdema is prevented by the subsequent use of a zinc-gelatine bandage

Marked displacement of the fragments should be corrected by manipulation This is particularly important in fractures of the necks of the metatarsals, where imperfect reduction always causes permanent disability It may be necessary to use traction by means of a pin or wire through the pulp of the toes attached to a ' banjo splint ', which is incorporated in the plaster The traction is continued for three weeks

FRACTURES OF THE TOES

The most common injury to the toes is the comminuted fracture of the terminal phalanx of the great toe due to crushing by a weight Serious displacement of the fragments is rare, but there is extreme swelling and ecchymosis and the toe nail frequently comes off As a rule, protection by collodion ribbon gauze is sufficient Early weight-bearing is possible if a metatarsal bar is screwed well forward on the sole of a boot, the toe of which is cut out

CHAPTER XLVI

THE TREATMENT OF TUBERCULOUS JOINTS

By F P Fitzgerald

A tuberculous joint is a local manifestation of a systemic infection, and general treatment is consequently of great importance This consists of rest, good food, fresh air, and sunlight

THE HIP

The surgeon's aim is to relieve pain, arrest inflammation, control bone destruction, and prevent deformity If these ends are to be achieved, the joint must be kept at rest with the limb in extension Muscle spasm round the hip-joint is the chief agent which keeps up irritation and causes deformity It can be controlled by traction

The Application of a Strapping Extension.—

Materials —

1 A strip of strapping or extension Elastoplast is cut to the required length. This length is obtained by measuring the limb from the perineum along the inner aspect of the leg to 4 in below the heel, and up the outer aspect of the limb to the greater trochanter

2 A wooden spreader, 3 in by 3 in, perforated in the centre for the extension cord

3 Extension cord

4 Weights, 3 to 8 lb, depending upon the weight of the patient and the amount of muscular spasm

5 A pulley, the position of which can be altered in either the vertical or horizontal plane

6 A Liston's long splint, which can be fixed to the end of the bed

7 Blocks to elevate the foot of the bed

8 A knee-pad with tapes

9 An aluminium gutter splint, reaching from mid thigh to mid calf, for the lateral aspect of the limb

10 A heel rest, two pieces of adhesive felt, and gauze bandages

11 A right-angled back splint with transverse cross piece to prevent rotation

Method —The spreader is fixed to the strapping so that the perforation is over a mark which coincides with the mid-point of the heel The extension is applied along the inner and outer aspects of the limb, the spreader being kept at right angles to the long axis of the leg The strapping is freed from creases by nicking the edges obliquely, the small pieces of felt are placed over each malleolus, and the felt and strapping are fixed by the gauze bandage The knee pad, which prevents hyperextension and consequent stretching of the ligaments, is tied in position behind the knee The gutter splint, used to avoid genu valgum, is bandaged firmly into position along the outer aspect of the limb The right-angled back splint is fixed along the leg and foot The Liston splint is laid along the sound side of the patient It is held in position above by a many-tailed bandage, and below by a flannel bandage Straps may be used instead The splint is attached to the foot of the bed and prevents tilting of the pelvis The cord is passed through the hole in the spreader and knotted several times on the proximal side Preferably no weights are attached for at least twenty four hours (*Fig* 375)

The Line of Pull—When the extension has been applied and the end of the bed elevated by means of the blocks, the line of pull must be regulated If the hip is in a position of deformity, the pull must, at first, be in the line of this deformity—that is, if the hip is flexed and adducted, the pulley must be raised and moved nearer to the middle of the foot of the bed Steady traction in this plane will overcome the muscular spasm Gradually the line of pull can be altered until the desired position is obtained, with 20° abduction, a few degrees of flexion, and without rotation

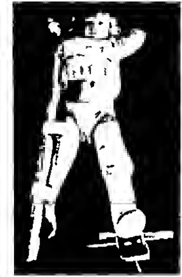


Fig 375 —Simple strapping extens on.

Abduction Frames—In the majority of cases the above method of immobilization is satisfactory Some children, however, complain of severe shooting pains in the hip, especially at night Others are so unruly that something

Fig 376 —Jones's abduction frame Note foot cradles to hold the weight of bed-clothes The frame is on blocks for nursing purposes

further is necessary to keep them quiet In these cases, the patient should be nursed on a Jones's double abduction frame There are many types of this frame, the best is that modified by Seddon (*Fig* 376) In fixing a child to such a frame, extensions are applied to both lower limbs and are fixed to the ends of the frame

When ordering a frame, the following measurements are necessary —

1 Circumference at nipple line
2 Distance from nipple line to greater trochanter
3 Distance from greater trochanter to lateral malleolus
4 Circumference at umbilicus
5 Distance between the anterior superior iliac spines

Stages of Treatment—

Active Stage—Adequate immobilization, with proper general treatment, is all that is necessary unless complications occur This stage lasts for not less than two years

Special care During this period it is necessary to reapply the extension when it slips, to watch carefully for pressure sores, especially at the malleoli and the heel, and to examine the child at weekly intervals for the development of an abscess If an abscess develops it is aspirated under aseptic conditions, the needle being inserted through healthy tissue The pus is sent for examination —direct film, culture, and guinea pig inoculation It is a mistake to inject any antiseptic into the abscess cavity after the aspiration The blood sedimentation rate is estimated regularly Serial radiographs are taken at three-monthly intervals The active stage is complete when (*a*) There is no muscular spasm

produced by passive movement, (*b*) The last three radiographs show no further bone destruction, (*c*) The sedimentation rate is normal

Quiescent Stage—The disease is now quiescent locally and generally, but as the child has been in bed for a long time, the condition of the heart and muscles is below normal This stage consists of getting the child up in a short, walking

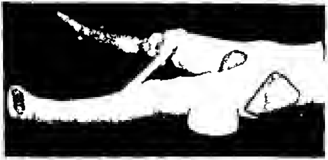


Fig 377—Seddon's operating spica The lid is replaced in the window area after operation Pressure can be applied over it to prevent oozing

plaster spica (*see Fig* 306) for three months The plaster splint prevents the development of deformity, guards the hip from sudden strain, allows the head of the femur to be forced into the acetabulum, and encourages free movements at the knee-joint

Operative Stage—In this stage the child is put into an operating plaster spica (*Fig* 377), and Seddon's *extra-articular arthrodesis of the hip* is performed The child is kept in bed in this cast for four months Any residual deformity can be corrected later by a subtrochanteric osteotomy

Convalescent Stage—The patient is allowed up in a short walking spica, which is worn for from six months, or until the fusion of the joint is beyond doubt When this plaster has been removed no splint of any kind is used, for the disease is arrested

End-results of this Treatment.—*These are extremely good* There is no chance of the deformity recurring, the disability is surprisingly small, and the patients are able to walk with scarcely a limp Recrudescence is most unlikely as the fibrous ankylosis has been converted into bony ankylosis If the joint is not arthrodesed, and, instead, a hip splint is fitted at the end of the quiescent stage, deformity is almost certain to occur

THE KNEE

Treatment in Children—

Active Stage—The knee is treated by extension in a Thomas splint until the disease is quiescent (*Fig* 378) The exact time depends on the appearances of serial radiographs Abscess formation and pressure sores should be watched for and treated

Quiescent Stage—A walking calliper is worn until the age of sixteen This prevents deformity and does not hinder growth

Operative Stage—The knee is arthrodesed by excision of the joint surfaces It is immobilized in a few degrees of flexion by a long plaster spica (p 261), or a Thomas splint This is retained for three weeks

Convalescent Stage.—A skin tight walking plaster is applied from groin to toes, and weight-bearing is encouraged. Bony union may take six months or longer, and is determined clinically and radiologically.

Treatment in Adults.—Mild early cases and late cases with much bone destruction and sinus formation are treated by arthrodesis as above. When the

Fig. 378.—Tuberculous knee treated by extension in a Thomas splint, showing method of supporting the splint and keeping the heel off the bed. Note the "Spanish turn" rod between the extension cords to increase traction.

local condition is acute, with marked swelling, conservative treatment in a Thomas splint is employed until the reaction subsides. Operative measures are then indicated. Amputation is rarely necessary.

THE ANKLE AND FOOT

In children the condition is best treated by immobilization in plaster until serial radiographs show no further bone destruction. If abscess formation is suspected, a window is cut for observation. Then a moulded leather stocking with steel struts is worn for two years. In adults over twenty amputation is indicated.

THE SHOULDER

Treatment in Children.—

Active Stage.—The joint is immobilized in a plaster spica (*see Fig.* 301). It is fixed at 30° in front of the coronal plane and abducted to 90° until the disease is quiescent.

Quiescent Stage.—Fixation is discarded. No attempt is made to prevent adduction.

Operative Stage.—At the age of sixteen years the joint is arthrodesed. It is fixed in a plaster spica as in the active stage until bony union occurs.

Treatment in Adults.—Acute cases are treated conservatively until quiescent. Otherwise the joint is arthrodesed in 45° of abduction.

THE ELBOW AND WRIST

When the elbow or wrist is involved, the treatment consists of immobilization in plaster until radiographs show no further destruction of bone. The elbow is fixed above or below a right angle depending on the patient's occupation. The wrist should be in slight dorsiflexion, the forearm being in the mid position in both cases. A moulded leather splint reinforced with steel is worn in either case for two years after the plaster has been removed.

The Elbow.—In children, the limb is immobilized in plaster extending from the axilla to the palm. The elbow is fixed at 90° and the forearm in the neutral

position When the disease is quiescent, a moulded leather splint from the axilla to above the wrist is worn

In adults, similar treatment is usually necessary, but in selected cases the joint may be excised

The Wrist—The joint is fixed in plaster in slight dorsiflexion and ulnar deviation until quiescent A moulded leather splint reinforced with steel is then supplied In selected cases the wrist may be arthrodesed by a bone graft When multiple sinuses are present amputation is indicated

THE SPINE

Stages of Treatment—

Active Stage—The initial treatment of a tuberculous spine depends on the age of the patient If an adult, he should be treated in a plaster bed (*see Fig* 313) until the disease is quiescent If a child, an angulated Bradford frame should be used until the disease is quiescent, usually at the end of two years

Fig 379—Position of patient on Bradford frame The angle of the patient is at the level of the lesion. The angulation can be moved gradually

The Bradford frame (Fig 379) This is a rectangular splint made from gas-piping, with a split canvas mattress' stretched between the sides The division in the canvas is for nursing purposes

Measuring the frame It is important that the frame should be measured accurately, as otherwise sagging will occur The length of the frame is equivalent to the height of the patient with 12 in added to this measurement The width is the distance between the axillæ The frame is angulated at the level of the lesion, so that the maximum convexity is in contact with the apex of the kyphosis The angulation is 10° at first This is increased at monthly intervals up to 30°, so that the spine is hyperextended

Special care Radiographs are taken at three-monthly intervals The blood sedimentation rate is estimated regularly Attention is paid to pressure points It is most important to examine for the development of a psoas abscess, this is done by weekly *deep palpation* in the lateral part of the iliac fossæ A psoas abscess should not be allowed to 'point' It is aspirated (*Fig* 380) while still deep with a trocar and cannula, the latter being adapted for a syringe Pus is sent for pathological examination Routine urine examination is necessary Prolonged dorsal decubitus is an occasional cause of hæmaturia, pyelitis, and urinary calculus In the absence of any organic lesion, such as renal tuberculosis, the patient is nursed in the prone position for a few days The angle of the frame is diminished before the child returns to the extended position When the last three radiographs show no more bone destruction and the sedimentation

rate is normal, the active stage has been completed and the Bradford frame may be discarded

Quiescent Stage—While the child is on the frame the diseased vertebræ are prevented from falling together by the hyperextension As the result of treatment the bones are no longer soft, and since they must be brought into apposition if bony union is to occur, the patient is now nursed face downwards in an anterior plaster shell (*see Fig* 312) This position favours three things the apposition of the vertebral bodies, the development of the back and leg muscles, and the formation of compensatory curves above and below the lesion This stage lasts for three months

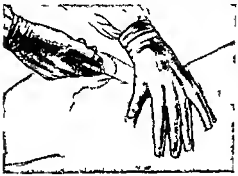


Fig 380—Aspirating a psoas abscess

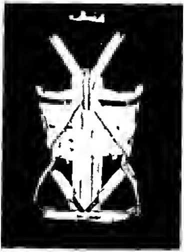


Fig 381—Spinal support Note moulding over iliac crests

At the end of three months the very difficult question of a spinal graft has to be faced If on radiological examination the diseased vertebral bodies have even outlines, have come into apposition fairly accurately, and show no sign of cavitation or sequestrum formation, the child may be allowed up without a spine graft, but a spinal support (*Fig* 381) should be worn for two years If, on the other hand, these features are absent, an Albee type of spinal fusion must be performed

Operative Stage—A plaster bed is made a month before operation Three days' skin preparation is necessary for the leg from which the tibial graft is to be taken The blood is typed in case a transfusion is necessary For the next four months he is nursed in the plaster bed

Convalescent Stage—A spinal support is worn for two years

CHAPTER XLVII

THE FOOT, WITH SPECIAL REFERENCE TO MANIPULATIONS

By F P Fitzgerald

FLAT-FOOT OR FOOT STRAIN

Treatment in Relation to Age—

The Young Patient—A young patient who is standing most of the day and who has complained of pain for a short time needs a course of faradic foot baths, massage, and flat foot exercises If this does not relieve symptoms after four to six weeks, manipulation and further physical treatment is indicated

Fig 382—Plantar flexion

Fig 383—Dorsiflexion.

Fig 384—Inversion.

Fig 385.—Eversion

The Middle-aged Patient—The patient of thirty to forty five years of age, in whom the condition has persisted for many months, should have the foot manipulated under an anæsthetic This is followed by a course of physiotherapy as above

The Elderly Patient—The old person whose feet are still fairly mobile and in whom the rigid osteo-arthritic foot has not developed, is treated by a course of physiotherapy as above, and is provided with a gutta percha arch support moulded to the long and anterior arches

Arch Supports—These should not be prescribed indiscriminately The cases should be carefully selected, and the supports made specially to fit the individual foot *Arch supports should never be ordered for a young patient with mobile feet*

Manipulation of the Foot.—(*a*) A preliminary radiograph is essential, (*b*) The patient is anæsthetized on a low table, preferably with an intravenous anæsthetic The feet are near the end of the table and rest on a Sorbo rubber mattress

1 *Plantar Flexion*—The heel is grasped in the left hand and the foot in the right, the palm being placed along the dorsum The foot is then plantar flexed (*Fig* 382)

2 *Dorsiflexion*—The right hand is transferred to the plantar surface of the foot and the foot dorsiflexed (*Fig* 383)

3 *Inversion*—For the left foot, the right hand grasps the foot so that the palm is on the dorsum at right angles to the long axis of the foot, and full inversion is carried out by a rotary movement (*Fig* 384) The hands are reversed for the other foot

4 *Eversion*—The foot is grasped between both hands, with the fingers interlocked along the outer border, and full eversion obtained by a rotatory movement (*Fig* 385)

These movements are carried out sharply and forcibly

SPASMODIC FLAT-FOOT

Treatment—The patient is usually a youth whose work entails much standing The foot is manipulated into full inversion under an anæsthetic It is maintained in this position in plaster for six weeks

After treatment—When the plaster has been removed, the patient is fitted with a short outside steel and an inside T-strap The boot is altered so as to have a quarter inch inside wedge on sole and heel, and a valgus pad under the long arch of the foot To save time, the instrument and alterations to the boot should be ordered *before* the manipulation is performed

This instrument should be worn until all spasm and pain have disappeared If the patient s work necessitates much standing, he should be advised to change his occupation

TENDER HEELS

A tender spot can be found on pressure on the plantar surface of the heel A radiograph may reveal a spur arising from the under surface of the os calcis In other cases no spur is seen but on further examination the patient may be found to have a highly arched foot with a narrow weight bearing heel surface A new pair of shoes in which the surface for the heel is flat instead of concave is another cause of the complaint In any of these cases it is wise, at first to fit a sponge rubber insole shaped to take the heel. In addition a course of local diathermy for several weeks is desirable If conservative treatment fails a painful spur may be removed through a small incision along the inner aspect of the heel.

CONGENITAL TALIPES EQUINOVARUS

Treatment.—This condition is best treated by repeated manipulations and the application of Denis Browne's splints and boots (*Fig* 386) It is essential that treatment should be initiated during the first few weeks of life No anæsthetic is then necessary

Measuring for the Splints—The splints are made from 12 gauge aluminium, in three sizes, thus —

X–X and Y–Y	3½, 4½ and 6 in
Z–Z	1¼, 1½, and 1¾ in
Cross bar	1¼ by 5 in 1½ by 6 in 1¾ by 6½ in

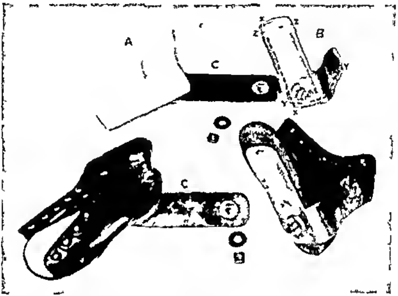


Fig 386—*Denis Browne's splints and boots* A Right splint B Left splint, C, Cross bar A larger splint is used *for the boots* (*see* p 348) *but the same cross bar* X X Y Y Z Z Measurements of splints (*see text*)

It is essential that the lower part of the leg piece be well curved out to accommodate the external malleolus, which may otherwise develop a pressure sore

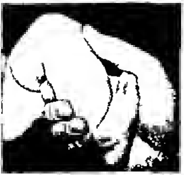


Fig 387—One-hand method used by Denis Browne

Fig 388—Felt pads applied to the *sole of the foot.*

Manipulation.—At the first sitting the foot is forcibly dorsiflexed and everted until it is possible to touch the anterior surface of the leg with the little toe. Browne does the manipulation with one hand (*Fig.* 387).

Application of Felt Pads.—Following the first manipulation, when swelling is to be expected, felt pads are not used. Thereafter a quadrilateral piece of ½-inch adhesive felt approximately equal to the size of the sole is cut diagonally to form two triangular strips. These are pressed together to form a double thickness and then applied to the outer aspect of the sole and toes (*Fig.* 388).

Application of Splints.—The cross-bar must be removed and the splints put on separately. The sole-plate is placed along the sole of the foot with the felt in position, the nurse holding the splint in place, and at the same time *pressing the heel and the inner border of the foot firmly against the plate*. The surgeon binds the foot to the sole-plate with 1 in. strapping (*Fig.* 389). A turn is taken around

Fig. 389.—The fore-foot is strapped to the sole plate. The vertical leg piece has not yet been swung into position. The strapping on the leg is covering an abrasion.

Fig. 390.—The application of the splints completed in a bilateral case.

the heel, and then the leg piece of the splint is swung into position and fastened to the leg with a few more turns of strapping. The cross bar is fixed in place, the feet being rotated outwards into the 'Chaplin' position (*Fig.* 390). A normal foot is placed in 20° and a club-foot in 60° or more of external rotation. If one foot is normal, the felt pads are omitted on that side and a single felt strip cut to the size of the sole is substituted.

After-treatment.—The child should never be allowed to leave hospital until it is certain that the circulation of the toes is satisfactory. The feet must be fully manipulated into the over corrected position and the splints reapplied at regular fortnightly intervals until the manipulation can be performed easily and painlessly. This takes approximately six months. Then the child is fitted with the special 'hobble' boots (*see Fig.* 386) to wear *at night*, until voluntary eversion is possible. They are fixed in the same angles of external rotation as the splints. During this period, which lasts for about two years, the mother manipulates the foot three times daily. If relapse is threatened, immediate resumption of the splints is necessary. Recently, Denis Browne has devised a new night splint (*Fig.* 391) instead of the 'hobble' boots. It consists of a metal

grip which is strapped to the thigh just above the knee From this a strap passes down the back of the heel, then along the sole of the foot and upwards to reach the lower part of the grip once more

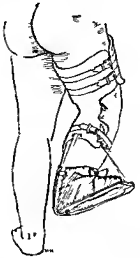


Fig 391—The new Denis Browne night splint fixed in position Note that the knee is flexed and the foot is maintained in the calcaneus position

Later cases Cases commencing treatment when more than six months old need manipulation under anæsthesia and plaster in full eversion and dorsiflexion at intervals of four weeks When the deformity can be fully corrected without an anæsthetic the Denis Browne routine may be commenced

CHAPTER XLVIII

MINOR OPERATIONS ON THE FEET

By F P Fitzgerald

Before any open operation is performed upon the foot scrupulous cleansing is necessary It is often advisable to spend several days in the pre-operative preparation of the skin

IN-GROWING TOE-NAIL

Palliative Treatment—A common form of treatment is to lift the nail up gradually from its bed by packing a pledget of cotton wool soaked in flavine beneath its edge once or twice a day When the nail has been elevated the offending sharp splinter can be excised

Fig 392—Wedge resection operation for in growing toe nail.

The Wedge Resection Operation.—This is indicated in comparatively early cases An Esmarch s bandage is applied and tightened about the calf The incision begins a quarter of an inch above the eponychium on the affected side It is continued distally through the nail to its free edge so as to include the diseased part and the adjacent quarter of the nail. Another incision joins the extremities of this cut by passing through the skin an eighth of an inch from the affected margin (*Fig* 392)

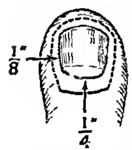


Fig 393—Excision of the nail bed

Both incisions are deepened, and the nail edge with its attached bed and skin is removed It is essential that all the nail bed be removed completely from the phalanx The skin margins are sewn across with a few interrupted sutures

Excision of the Nail Bed—This is indicated in severe cases If obvious sepsis is present, the nail is avulsed and operation deferred for a month An Esmarch s bandage is applied as described above A horse shoe shaped incision, open proximally, is made in the skin around the nail an eighth of an inch from the edge The extremities of the horse-shoe are joined one quarter of an inch from the root, by an incision which is convex

proximally (*Fig* 393) The wound is deepened down to the phalanx and the nail with *every remnant* of its bed and the adjacent skin is removed The distal one third of the phalanx is dissected free and excised with bone forceps The rough bone surface is smoothed with a file, and the distal skin flap sewn into place with interrupted sutures

Avulsion of the Nail—This is indicated in onychogryphosis, and in septic cases, as a preliminary to the above operation

Subungual Exostosis—In minor cases, local excision of the nail and curettage with a sharp spoon is sufficient A large exostosis may require preliminary avulsion of the nail

CORNS

Conservative Treatment—This consists in repeated applications of corn paint, the use of corn plasters, and paring the corn after bathing

Operative Treatment—Excise the corn by a transverse elliptical incision, as in the operation for hammer toe It should be remembered, however, that so long as the hammer toe or tight shoe remains, no treatment will be permanently effective

Plantar Warts—(See p 455)

HAMMER-TOE

A simple hammer toe should never be amputated The deformity can be permanently rectified by Higgs's spike arthrodesis (*Fig* 394)

Operation—The contracted extensor tendon is tenotomized over the meta tarso phalangeal joint and the toe is forcibly flexed A transverse elliptical incision is then made across the affected joint so as to include the corn which is usually present This piece of skin is removed and the joint opened by cutting across the extensor tendon Incidentally, it should be mentioned that the ends of the tendon unite without suturing The articular ends of both bones are then elevated With an awl (*Fig* 395), a hole a quarter of an inch deep is bored in the base of the distal phalanx The distal end of the proximal phalanx is then shaped with a small bone forceps to form a spike, care being taken to preserve the cortical bone on the upper surface The spike is pushed firmly into the hole (*see Fig* 394), and the skin sewn with two or three interrupted silk worm gut sutures

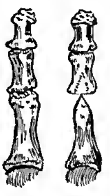


Fig 394—Higgs's operation for hammer toe

Fig 395—Paton's awl for hammer toe operations

After treatment—The toe is dressed with a few layers of gauze soaked in collodion, which forms an efficient splint The dressing is discarded at the end of three weeks, but the patient need not be prevented from walking during this period The only contra indication to the operation is poor circulation, such as occurs in the aged Gangrene is a possible complication when the nutrition of the digit is subnormal

HALLUX VALGUS

Conservative Treatment.—This is seldom effective A young patient is fitted with a hallux valgus splint (*Fig* 396) to wear at night

Operative Treatment —

INDICATIONS —The principal indication for operative interference in hallux valgus is pain The extent of the operation depends on the site of the pain If there is no pain in the joint when walking barefoot, but the exostosis is tender, the operation may be confined to excision of the exostosis If there is pain on moving the joint an arthroplasty should be performed

Fig 396 —Hallux valgus splint

TECHNIQUE —

Excision of the Exostosis —An incision, 1½ in. in length, is made over the dorsal aspect of the joint on the medial side of the extensor tendon The skin and bursa are retracted, the terminal branch of the saphenous nerve preserved, and the exostosis cleaned The exostosis is removed with an osteotome, and the cut surface smoothed with a file

Excision of Base of Phalanx —The incision is deepened and the capsule dissected back to expose the joint The base and shaft of the phalanx are now cleaned A sharp hook is driven firmly into the cartilaginous base of the phalanx, which is distracted forwards, thus separating the joint surfaces (*Fig* 397)

This allows the flexor tendon to be dissected and freed The base of the phalanx is now gripped firmly in a lion forceps while the proximal end of the shaft is cut through with a saw Up to half of the phalanx may be removed The rough edges of the divided bone are filed smooth and the skin is approximated by means of closely placed interrupted sutures

AFTER TREATMENT —The toe must be left completely at rest until the sutures are removed on the tenth or twelfth day Then

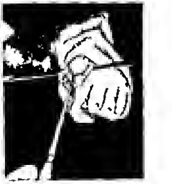


Fig 397 —Excision of the base of the phalanx. The head of the metatarsal is elevated by two bone spikes. The phalanx is pulled forwards by the bone hook.

Fig 398 —Shoe fitted with metatarsal bar

movements and toe-stretching exercises are begun and continued for a few weeks If it is noticed after the operation that the patient is not walking 'down' on the great toe-joint, the *sole* of the shoe should be fitted with a one-sixth of an inch outside wedge

HALLUX RIGIDUS

In this condition the toe is straight, but dorsiflexion is limited The toe is usually fixed in slight plantar flexion, while there is compensating dorsiflexion at the interphalangeal joint

In cases of moderate severity the toe is manipulated A piece of gauze is wrapped around the toe and the joint forcibly stretched The surgeon, still maintaining traction, puts the toe through *all* its movements This is followed by a course of diathermy to the joint

In more severe cases a metatarsal bar, three-quarters of an inch wide, should be fitted to the sole of the shoe, just behind the tread (*Fig* 398) If pain persists in spite of conservative treatment, arthroplasty similar to that just described is recommended

CHAPTER XLIX

BURNS

By A J C. Latchmore

It is the amount of surface involved which determines the seriousness of a burn The first problem which confronts the practitioner is "Does this case need hospital treatment?" In assessing this important question it is useful to imagine the burnt area infected and then ask yourself the question again

MINOR BURNS

Those cases which are slight should be cleansed as thoroughly as possible before removing the blisters After these have been cut away an antiseptic is applied Such cases do well on many forms of treatment A good method is to apply Dettol burn cream or one of the tannic acid jellies on gauze and cover it with a bandage No wool should be used because evaporation is to be encouraged When mobility of the part is essential, flexible adhesive plaster may be applied directly over the cleansed areas This need not be removed for several days

SEVERE BURNS

After receiving a severe burn, the patient becomes dangerously ill and remains so for many weeks The causes of this illness have been widely investigated, and are here summarized, because it is impossible without such knowledge to undertake treatment. Although the illness is continuous it has been sub-divided into four stages

1 *Primary Shock* is thought to be nervous in origin and due to the great pain of the burn, and is only present in striking degree in the most severe cases

2 *Secondary Shock* has been proved to be largely due to loss of fluid from the burnt areas This loss occurs both externally into the blisters and as a continual subsequent weeping, and also into the tissues beneath the burn. This is demonstrated clinically by the swelling of the burned parts which inevitably occurs It has been shown experimentally that in this way 40 per cent of the total circulatory volume may be lost. The loss of fluid can be measured clinically by hæmoglobin estimations, which as the blood becomes more concentrated may rise to 140 per cent.

3 *Toxæmia*—In certain cases about the fourth day or later the clinical picture resembles that of a poisoning The patient is restless, often delirious, and has a rapid pulse, and vomiting is frequent Even jaundice may occur In fatal cases the salient feature is a central necrosis of the liver lobules, which is strongly suggestive of the action of a toxin The basic idea of the tannic acid treatment was that such poisons were split protein products, formed by the action of the heat of the tissues, and that their absorption could be prevented by coagulating them on the surface of the burn by the action of the tannic acid Since the introduction of tannic acid, the incidence of toxæmia has decreased, but it has by no means disappeared

4 *Infection*—The final and longest stage of the illness is characterized by continued pyrexia, and is due to infection of the extensive granulating surfaces The patient's general physical state and morale are lowered by the infection and the great pain of repeated dressings Let us now consider how the course of these events can be stayed by appropriate treatment.

TREATMENT

First Aid—In severe cases which are to be sent into hospital the practitioner should administer morphia and keep the patient warm and do nothing to the

actual burns except free them from clothing and cover them in sterile dressings or clean sheets Any further local treatment is best postponed until the patient reaches hospital

General Treatment—

Primary Shock—Morphia in doses sufficient to procure rest, warmth in a radiant heat cage, fluids by mouth, and freedom from all other intervention constitute the treatment If fluids are vomited, plasma should be given by continuous intravenous drip

Secondary Shock—The best means so far available of lessening the fluid loss from the burns is coagulation of the raw area by means of various agents, of which tannic acid is the most widely used

Local Treatment.—

Coagulation Methods—

The Time of the application is a matter for fine judgement The earlier it is done the better, provided that the patient is no longer suffering from shock, but many patients have been killed by too early and too thorough toilet

The Solution—To a large extent this is a matter of personal choice

Tannic acid solutions varying from 2½–20 per cent The stronger solutions are better because the coagulum is quickly formed, can be dried in the theatre, and does not need to be touched again for many days This lessens the chance of subsequent infection The great drawback of tannic acid solutions is that they have no antiseptic power They must also be freshly made for each case, moulds form in them otherwise

Tannic acid solutions in antiseptics, such as 1–1000 acriflavine, have been widely and successfully used in an attempt to remedy the above deficiency

Combination of tannic acid and silver nitrate A 5 per cent solution of tannic acid is applied, and this is followed immediately by the application of a 10 per cent solution of silver nitrate

Triple dye—Consists of an aqueous solution of brilliant green 1 per cent, gentian violet 2 per cent, neutral acriflavine 0 1 per cent, which produces a similar but perhaps more supple coagulum than tannic acid Its sole advantage is that it is antiseptic, and in cases in which toilet has to be minimized for fear of increasing shock, it is therefore better than tannic acid

Technique of Local Coagulation—The basic principle of the method must always be borne in mind If the burns are rendered sterile by careful toilet, coagulated and maintained sterile afterwards, perfect healing without sepsis and without scarring will occur under the tan *provided that the whole thickness of the skin has not been destroyed*

Much of the disrepute into which the tannic acid treatment has fallen has been due to a lack of appreciation of the difference between second-degree and third degree burns In the former, where islets of epithelium remain at the mouths of sebaceous glands and their follicles and between the papillæ of the 'wavy line' of the skin, healing occurs by growth of epithelium from multiple points on the surface of the burn These soon meet one other with the result that rapid and perfect healing occurs If the whole thickness of the skin is, however, destroyed (and who by inspection can in every case discern how far the heat has penetrated?) then, under the tan is a wide area devoid of all skin, which can only heal, whatever the treatment, by granulation tissue, scarring, and the infinitely slow ingrowth of epithelium from the far separated edges

Whenever the condition of the patient permits, he should be taken to the theatre, anæsthetized with gas and oxygen, and the burnt areas gently cleansed with soap solution or saline, followed by a weak solution of Dettol The areas

should then be dried with gauze swabs or gauze soaked in ether, and the coagulating solution applied, and the areas then dried with an electric hair drier (*Fig* 399). This operation should be carried out rapidly with several assistants with the ever-present fear of increasing the shock dominating the surgeon's mind. The coagulum will be produced in a few minutes and the areas when dried should be wrapped in gauze and pinned in sterile towels, and the patient returned to the ward.

In the most extensive burns, the ideal of obtaining asepsis must be abandoned. The burns should be gently cleansed a part at a time, in the patient's bed. Triple dye should then be painted over them with a gauze swab and allowed to dry under the radiant heat. In this way a few lives which would otherwise have been lost will be saved.

Fig 399.—Illustrating the application of 20 per cent tannic acid solution to burns after careful toilet under gas and oxygen anæsthesia. The hair drier enables several coats to be applied in a few minutes.

Replacement of Fluid.—In all severe cases, where extensive loss of serum is inevitable, continuous plasma infusion should be instituted on admission or on return from the theatre. The amount necessary must be checked by frequent hæmoglobin estimations. In one recent case the hæmoglobin rose to 138 per cent in spite of the administration of 15 pints of plasma-saline solution in the first few days.

Such cases offer the most convincing indication for the use of plasma, because one is replacing almost precisely the fluid which is being lost, and such transfusion does more to save life in this stage than any other measure.

Toxæmia.—

Prevention.—The reason for the introduction of the coagulation treatment of burns was the prevention of the absorption of toxins and there is no doubt that the incidence of toxæmia has thereby been lessened.

Treatment.—When established, toxæmia should be treated by continuous intravenous glucose saline because of the liver damage. There is some evidence that adrenal cortical hormone, or a synthetic preparation, desoxycorticosterone acetate or D.O.C.A. given in 5 mg. doses, two hourly, intramuscularly, is of value.

INFECTION

Prevention —

Rendering the Area Sterile —As described above this should be the easily obtainable ideal in all but the most extensive burns, in which cases the ideal must be abandoned for fear of dangerously increasing the shock

In the cleansing, meticulous attention to detail is amply repaid For instance, it seems obvious that in burns of the hands, the nails should be cut short and scraped clean, and in burns of the face, the hair should be shaved well back from all affected areas

Maintaining the Area Sterile —

Special nurse For the first few days a special nurse should be provided for all extensive burns The toilet in the theatre is futile if the patient is allowed to vomit over the tanned areas on her face (*Fig* 400) and neck and displace her dressings while recovering from the anæsthetic The attentions of a nurse to control restlessness, to wipe away nasal and oral secretions, and to dab the soiled, tanned areas with a 1 per cent solution of brilliant green in 30 per cent alcohol, and to keep careful check on the fluid intake and output, are essential

Fig 400 —Showing the excellent coagulum produced by 20 per cent tannic acid painted on to burns of the face This will peel off and leave no scar

Dressings The dressings must fulfil two conditions Firstly, they must be *thin*, in order that evaporation may occur readily Thick dressings with wool allow the serum, which still exudes to some extent despite the tan, to moisten it and thus predispose to infection Secondly, they must stay in place For a limb, the best dressing is to wind a 9 in roll of gauze around it, and over this lightly pin a towel It will be found that the parts which commonly become septic are those to which the air has not free access In the arm, the axilla and under surface which lie on the bed become moist In the hand the webs of the fingers are the vulnerable points The patient must be encouraged constantly to alter the position of his arm and it is valuable to have an electric hair dryer plugged into the wall at the bedside, so that the patient or nurse can apply it from time to time, over the thin dressings The fingers if treated with tannic acid must be bandaged separately and wide apart, and movement encouraged In order to ensure that the tan is kept dry, some surgeons advocate no dressings at all, and for the patient to lie under radiant heat apparatus between sterile sheets It is my experience, however, that the sterility of the sheets is only transient and that this method is inferior to the parts being covered with a light dressing, except in burns of the face In the absence of gross infection, there is no point in disturbing the dressings until the tan is beginning to separate

Treatment of Established Infection —

GENERAL —Cultures from the burn should always be taken, and as in the majority of cases the infection is streptococcal, sulphonamide therapy is of great

value In most cases it should be given by mouth, but it may also be applied locally as a powder or as a glycerin paste The patient's general condition, which is always poor at this stage, should be built up in every possible way Anæmia should be corrected by iron tonics and small repeated blood transfusions, if necessary Vitamins A and D can be prescribed with advantage Some of these patients respond well to treatment in the open air and benefit by small doses of alcohol with their meals

LOCAL —This presents the same problems as does the treatment of any other huge infected wound, with one very important difference, namely, that being a wound of the skin, which is more richly supplied with sensory nerves than the deeper parts, the picture is more dominated by pain than in any other type of wound.

While great strides have been made in the treatment of the earlier stages of burns, it should be realized that it is in this last stage that the greatest suffering is experienced by the patient and that it is this stage which, at the moment, is the most difficult to treat

As in other infected wounds, there are widely different methods in use, varying from frequent irrigation with antiseptics at one end of the scale, to complete occlusion in plaster at the other The essential point to bear in mind is, however, that *if the whole thickness of the skin has been destroyed, there can be no healing, except by dense scar formation, unless the lost skin is replaced by grafting, and the sooner the area can be made fit for grafting, the better*

In second-degree burns, sepsis is readily cleared up if the tan is removed as soon as it is seen to be lifted up by pus If the tan is left untouched, second-degree burns may become converted into third-degree ones

In general, the possible forms of treatment which are practised at present may be grouped as follows —

1 *Minimum Interference* —It is believed by many that the thick adherent tan should be left undisturbed in third degree burns to separate very slowly over several weeks The rationale of this method is similar to the closed plaster treatment of other infected wounds, and a few surgeons go still further and actually enclose the burns in plaster Such treatment has one great advantage in that the patient's morale improves when the horror of repeated painful dressings is removed, but it is of very limited application, and its chief danger lies in the possible deepening of the burn referred to above

2 *Infrequent Oily Dressings* —This is the middle course and that most frequently followed The solutions used are emulsions of flavine or eusol in paraffin, and whilst these have been criticized in that it is said that the antiseptic power is lost because of the inert paraffin, they have proved most useful in practice Alternatively, wide-meshed vaseline gauze (tulle gras) is very successful This may be covered with a saline dressing, which is renewed eight-hourly, the vaseline gauze being soaked off at more infrequent intervals Such dressings have the supreme advantage that they stick less than aqueous solutions and lessen the pain of the dressings, which are otherwise unbearable There is an ineradicable tendency on the part of the nursing staff to overdo the dressing of burns, and this must be firmly controlled In widespread burns, dressings should be split up so that each part is done only every third or fourth day In certain cases it is best for the surgeon himself to do the dressing at similar intervals with light gas-oxygen anæsthesia and adequate assistance

3 *Irrigation and Saline Baths* —A recent development of promise has been the use of jap silk envelopes coated with a synthetic resin, which are made in

standard sizes to fit various parts of the body, particularly the limbs The envelope is sealed to the limb with adhesive strapping and inlets and outlets are provided for the irrigation (*Fig* 401) These were originally used for the treatment of the burn *ab initio* as a break away from the coagulation treatment It is too early as yet to assess their real value, but in places like the hand, where early movement is advisable, it is obvious that the method has great advantages It is also certain that the use of such irrigation envelopes will prove most valuable in cleaning up infected, granulating burns on the limbs, and to prepare them in the shortest possible time for skin grafting The method of irrigation originally used was by means of a continuous flow of 1 per cent electrolytic sodium hypochlorite from a container for twenty minutes two or three times daily In order

Fig 401 —The envelope method of treating burns

to avoid dermatitis and maceration of the skin, it is important to ensure free drainage and complete emptying of the envelope after the irrigation For this reason, oxygen from a cylinder is blown through after each treatment

Saline baths In burns of the limbs, especially of the hand and forearm, saline baths twice a day, followed by the application of vaseline gauze, has proved an excellent method The vaseline does not stick, and the limb is immersed in the bath with the dressing in position and the gauze allowed to float off in the saline

The saline bath treatment of widespread burns of the trunk is being attempted, but presents very obvious difficulties

Contra indications to Tannic Acid —As a result of recent war experience, the treatment of burns of the hands and face with tannic acid has been severely criticized In the hand, the argument is that a casing of firm coagulum prevents swelling of the fingers and thereby interferes with the blood supply and produces necrosis, and prolonged immobilization produces stiffness and a poor functional result As in burns of the hands the extent is not sufficient to give rise to danger from either secondary shock or toxæmia, there is no indication for tannic acid treatment, and it would appear therefore that treatment in saline or antiseptic baths with movements encouraged from the first is better In burns of the face, however, when meticulously cleaned up, excellent results may be obtained with tannic acid

Contractures —These are very difficult to avoid in burns over the flexor aspect of joints In such cases care must be taken to keep the joints splinted in

the most useful position, and to apply Thiersch grafts early The worst contractures are —

1 Webbed neck, due to scarring following burns on the front of the neck drawing down the skin of the chin and pulling on the lip

2 Those around the eyes, causing ectropion

3 Flexion contractures of the elbows

It cannot be emphasized too strongly that superficial burns do not cause contractures unless sepsis destroys the islets of epithelium which are present beneath the blisters Therefore, contractures in these cases should be preventable In deeper burns they can still be prevented by early splinting and skin grafting

Keloid Formation —This is an occasional and distressing late complication Its cause is not understood, and therefore its prevention is not always possible, but it can be minimized by (1) The more frequent use of Thiersch grafts (2) The use of X rays X rays are so valuable in restraining the fibrous tissue overgrowth that they should be used not only on the first sign of keloid formation, but as a prophylactic measure

CHAPTER L

SULPHONAMIDE THERAPY

By C ALLAN BIRCH

PREPARATIONS AND INDICATIONS

THE term ' sulphonamide ' embraces the whole of this important group of drugs It is unfortunate that the nomenclature of its subdivisions is so complex, largely due to proprietary preparations

Sulphanilamide is available as such, and has at least 32 synonyms, the best known being colsulanyde, prontosil album, streptocide, and sulphonamide P All these preparations are identical in chemical composition Sulphanilamide is employed for streptococcal and *B coli* infections *It is especially inimical to the hæmolytic streptococcus*

Proseptasine (syn benzylsulphanilamide) owes its action to the release of sul phanilamide in the body, and so is somewhat less active, but less toxic, than the same weight of sulphanilamide itself Being insoluble, it is only used orally It is recommended for prophylactic use and for urinary infections where high blood concentration is not needed

Sulphanilamide Preparations for Parenteral Administration.— There are a number of proprietary solutions of sulphanilamide in organic solvents, but *in many of these the doses recommended are inadequate If they are used* their sulphanilamide content must be known

Soluseptasine, a preparation similar to proseptasine, belongs to this category and is supplied in ampoules containing 0 25, 0 5, and 1 0 g It contains 40 per cent of sulphanilamide and depends for its activity upon the release of sulphanilamide in the body Being practically neutral, it is free from irritant effects

Prontosil soluble is a red dye now rarely used It also depends for its action on the sulphanilamide it produces The blood sulphanilamide rarely *exceeds 3 mg* per cent when this drug is used It is supplied in 5-c c ampoules of a 5 per cent solution The stains it produces on linen can be removed by a solution of sodium carbonate and sodium thiosulphate

It is not difficult to prepare a sterile solution of sulphanilamide The solubility of sulphanilamide in water or saline is 1 per cent at body temperature and a solution of 1 g of powder in 100 c c. of 0 5 per cent sodium chloride should be autoclaved at 115° for 30 minutes and cooled to body temperature before injection

Sulphapyridine (syn Dagenan, M & B 693) is used for meningococcal, gonococcal, pneumococcal, and gas-gangrene infections The soluble form is M & B 693 soluble (syn Dagenan Sodium) and is supplied in 3-c c ampoules containing 1 g

Sulphathiazole (syn M & B 760, Thiazamide) is used mainly for staphylococcal infections *It is also used in pneumococcal*, gonococcal, meningococcal, and gas gangrene infections in cases intolerent to sulphapyridine It is difficult to maintain high blood levels of this drug owing to its rapid elimination

It can be obtained in ampoules containing 1 g for intravenous use Owing to its relatively strong alkalinity it should never be given intramuscularly

Sulphadiazine has all the activity of sulphapyridine, and because of better absorption, smaller doses may be required In addition to the group of organisms listed under sulphanilamide, sulphadiazine is effective against experimental infections with Friedlander's bacillus

Sulphacetamide (syn Albucid, Sulphacetamide Sodium M & B) is a sulphonamide which has been used chiefly in gonorrhoea and urinary infections It can be obtained in 5-c.c ampoules of a 30 per cent solution which, not being strongly alkaline, is suitable for intramuscular injection

Sulphanilylguanidine is a newer sulphonamide, poorly absorbed from the gut It promises to be of use in dysenteric infections

RATIONALE

Sulphonamides are of most value against organisms of invasive character undergoing rapid multiplication and producing infections which run an acute course They are of less value in infections by organisms of lower virulence producing conditions of a chronic and localized nature

Because most sulphonamides are soon excreted, a high blood concentration should be attained rapidly When facilities exist, it is sometimes advisable to have an estimation of the concentration of sulphonamide in the circulating blood.

For blood estimation 2 c.c. of oxalated blood is used A fairly accurate micro-method using 0 2 c c. is now available also The effective blood concentration of sulphanilamide is about 10 mg per 100 c c Sulphapyridine is effective in lower concentrations such as 5 to 10 mg per 100 c c., though for staphylococcal infections a concentration of 15 mg per 100 c c. is necessary Higher concentrations than these are needed when sulphathiazole is used

Sulphonamides rapidly find their way into all body tissues, secretions and excretions, including discharges from wounds They do not effect bacteria in pus, but they assist in recovery once drainage is established

The concentration in the cerebrospinal fluid is generally *half* to two-thirds that in the blood Sulphonamides are not secreted in the milk in an amount sufficient to harm the breast fed infant Because sulphonamides are largely excreted in the urine, high urinary concentrations are easily obtained

DOSAGE AND METHODS OF ADMINISTRATION

Small, infrequent doses given on chance without clear indication are useless and dangerous In order to obtain a high concentration in the circulating blood, which is so necessary for effective treatment, four hourly administration day and night should be the rule, i e , six doses in the twenty four hours Oral administration is preferable in all cases The tablets of all the preparations contain 0 5 g , and usually at least two tablets are given at each dose If sulphonamides are going to be effective they soon show evidence of this, and a course of treatment should seldom exceed from seven to ten days Sulphanilamide may be given per rectum in 0 8 per cent solution, but high blood concentration is not usually attained.

In order to avoid accidental excess therapy it is wise to prescribe from day to day, or for seventy two or ninety six hours only At the end of each twenty four hour period the amount administered should be recorded It is usual to keep on with a small dose for several days after the desired effect is observed When using sulphapyridine and sulphathiazole a high fluid intake should be maintained in order to avoid excessive deposition of crystals in the urine

In all cases, if a second course of sulphonamide therapy is deemed necessary agranulocytosis must be excluded before a second course is commenced

Dosage for Children —Children tolerate sulphonamides well and require about half as much again per unit of body-weight as an adult If the weight is known, a simple rule is to give 1 gr per pound per twenty four hours Others give 1 g per 20 lb per twenty four hours The weight is difficult to obtain during illness, and the following table based on the weight at different ages will be found convenient

Age	*Dose in 24 hours*
0–3 months	0 75 g
3–6 months	1 0 g
6–18 months	1 5 g
1½–4 years	2 0 g
4–8 years	3 0 g
8–12 years	4 0 g

The blood concentration in children is apt to be variable and consequently estimations are valuable In meningococcal infections large doses are needed

Parenteral Administration —*As indicated above, several preparations are* suitable for parenteral use, but this method should not be undertaken lightly It is often preferable to give sulphonamides by œsophageal tube to patients who cannot swallow

Sulphanilamide, because of its low solubility, is not very suitable for parenteral injection, and solutions in special solvents are also relatively weak Soluseptasine is a good sulphanilamide derivative for intramuscular use

M & B 693 soluble is best given intravenously Being very alkaline it is irritant, and intramuscular injection should be avoided If it must be so given, it is wise to inject a little novocain before and after the drug

Thiazamide sodium should only be given intravenously

Local application of sulphonamide powder is now widely employed after excision of potentially infected wounds and, indeed, as a prophylactic measure in operative *incisions A dose of* 10 g *should rarely* be exceeded *If* the powder *is blown* into the wound with an insufflator, this amount will be found more than enough for even the largest wound

TOXIC REACTIONS

Early Reactions, Not Necessarily requiring Cessation of Treatment —

Cyanosis (with sulphanilamide) is usually due to methæmoglobin formation This usually can be ignored, but it must not be confused with cyanosis due to disease If the cyanosis *is intense and progressive*, sulphæmoglobin formation should be suspected, and can be confirmed by spectroscopy Since sulphides formed from sulphur containing foods such as eggs and onions are negligible in amount, *it is not really necessary to prohibit these foods*, but sulphate containing medicine (e g , magnesium sulphate) must be rigorously avoided Methæmoglobin cyanosis may be mitigated by methylene blue pills, 1 or 2 gr three times a day, or by a single dose of 2 mg per kilo body-weight intravenously

Vomiting (with sulphapyridine) is likely to prevent adequate absorption of the drug Often it can be avoided by fractional dosage, suspension of the drug in mucilage, large doses of potassium citrate, and the avoidance of smoking and constipation Nicotinic acid in 50-mg doses is recommended, though there is some evidence that it makes the drug less effective Early vomiting due to disease is an indication for parenteral therapy In later vomiting sulphanilamide may be substituted for sulphapyridine

Later Reactions, coming on after Five to Seven Days and requiring Cessation of Treatment.—

Sulphonamide Rashes are common and are usually associated with drug fever In children they may cause difficulties in the differential diagnosis of the exanthemata

Sulphathiazole is more prone than other sulphonamides to produce rashes One of the lesions it produces is indistinguishable from erythema nodosum, and is often associated with conjunctival injection These cases may show photosensitivity, porphyrinuria, stomatitis, and mental changes—the 'pellagroid syndrome'

Withdrawal of the drug, forcing of fluids, and giving nicotinic acid are the methods of dealing with the rash. Should the primary condition demand the continuance of chemotherapy, the sensitization to subsequent doses may disappear

Hæmaturia —Deposition of crystals in the urinary tract occurs chiefly with sulphapyridine and sulphathiazole, and may lead to lumbar pain followed by microscopic and macroscopic hæmaturia, oliguria, anuria, or renal colic, and occasionally to urolithiasis medicamentosa Dehydration due to vomiting, sweating, diarrhœa, and inadequate fluid intake all favour the condition, as also does poor renal function

Mental Symptoms produced by sulphonamides are rare, and resemble those of bromide intoxication—apathy, delusions, and hallucinations—and they rapidly disappear when the drug is stopped

Drug Fever is usually accompanied by rashes and is most often encountered in cases of gonorrhœa after seven days' treatment The fever disappears when the drug is stopped

Uncommon, Serious Reactions coming on after Fourteen Days' Treatment.—These are granulocytopenia, hæmolytic anæmia, peripheral neuritis, and jaundice Leucopenia is not important unless rapidly progressive to 4000 per c mm Since agranulocytosis is almost unknown before the fourteenth day of treatment, the fear of producing it by high initial dosage is unfounded. Prolonged suboptimal dosage, however, increases the risk of this complication

Hæmolytic anæmia, with jaundice and hæmoglobinuria, has occurred with sulphanilamide Treatment should be stopped, fluids administered, and blood transfused Subsequent use of the sulphonamide must be avoided

SOME INDIVIDUAL INFECTIONS IN RELATION TO SULPHONAMIDE THERAPY

Gas gangrene.—

Prophylaxis —In addition to wound excision and serum, the following scheme is recommended 1 5 g of sulphanilamide or sulphapyridine should be given at once, and then, beginning two hours later and continuing at 8-hourly intervals for 4 days, 0 5 g should be given, making a total of 13 5 g Local implantation should also be used

Treatment —Sulphanilamide or sulphapyridine should be used as follows. 2 g at once, followed in 2 hours by 1 g and then 1 g 4 hourly for 2 days After this the dosage is gradually reduced and the total should be about 35 g

Urinary Infections.—Sulphanilamide is effective in *B. coli* and *B proteus* urinary infections It acts in an alkaline urine (pH 7·7) The urinary concentration necessary is 50 mg per 100 c c, and even with renal impairment this is easily obtained by doses of 1 g 4 hourly since the urine concentration is from ten to twenty times that of blood A 0 8 per cent solution of sulphanilamide in

normal saline may be used for bladder irrigation Sulphanilamide is of value in urinary typhoid carriers

Gonococcal Infections —(*See* Chapter LXIV)

Meningococcal Infections —Sulphapyridine is the drug of choice and has reduced a mortality rate of 25–98 per cent to one of 5 per cent or less, irrespective of age Nine grammes in 24 hours should be given to an adult for three days, half the first day's dose being given in the first 8 hours The dose is then gradually reduced to 3 g a day over the next 6 days Doses as high as 3 g daily for the first three days may be used in infants The following table gives the dose for different ages for the first three days —

Age	*Daily Amount*
0–2 years	3 g
0–5 years	4½ g
5–10 years	6 g
10–15 years	7½ g
15 and over	9 g

The drug can generally be given as a watery suspension by spoon or tube, but intravenous injection may be required Lumbar puncture is only necessary for diagnosis and as a test of cure Daily puncture should be avoided since it removes the drug from the theca

Pneumococcal Infections —A good scheme in pneumonia is to give 2 g of sulphapyridine at once, 2 g four hours later, and 1 g every four hours for forty-eight hours The temperature falls to normal in thirty-six hours unless pneumonia is other than pneumococcal The rate of resolution is not altered but the mortality has been reduced from 20 per cent to 5 to 8 per cent Nicotinic acid in 50-mg doses is said to aid the resolution of pneumonia treated with sulphapyridine There is little effect on the organisms of respiratory catarrh except *H influenzæ* and Friedlander's bacillus

Pneumococcal meningitis should be treated as meningococcal meningitis and *any local focus*, e g, *otitis media, drained Sulphapyridine is effective* against all types of pneumococcal pneumonia and especially Types 1, 7, and 8

Staphylococcal Infections —Because of rapid and irregular absorption and elimination, big doses of sulphathiazole are necessary to maintain the recommended blood concentration of 15 mg per 100 c c Intravenous administration is *often necessary Four grammes should be given 4 hourly for 6 doses*, and then 3 g 4-hourly until 60 g have been given Another method is to give the sodium salt in a continuous drip transfusion One gramme in 100 c c saline at the rate of 25 drops per minute gives 1 g in 4 hours In staphylococcal septicæmia reliance should not be put on sulphathiazole alone, and 20,000 units of staphylococcal antitoxin of high anti-leucocidin content should be given

Other Infections.—Sulphanilamide has been used in many streptococcal diseases, but it is chiefly effective against those due to hæmolytic streptococci It has been used with success in puerperal sepsis and it should be given to all cases in which there is risk of puerperal infection, though mass prophylaxis is not advised It has no action in the toxic phase of scarlatina, though it may be useful for the septic and invasive complications It is of no value in diphtheria Virus Infections generally are not influenced except lymphogranuloma inguinale, and possibly other manifestations of lymphopathia venereum Brucella infections, actinomycosis, and erysipelas are favourably influenced. Sulphonamides have been used with some success also in tetanus, anthrax, and *B flexner* dysentery

CHAPTER LI

THE TREATMENT OF ABSCESSES

By Hamilton Bailey

GENERAL PRINCIPLES

As soon as pus has made its presence manifest, either by the phenomenon of fluctuation or by a softening or bogginess in an area of induration, no time must be lost in giving it an exit Most abscesses should be opened as soon as they have declared themselves, and they should be opened freely, with due respect to the anatomy of the parts concerned, and in such a position that drainage is favoured

Anæsthesia —For the opening of abscesses evipan anæsthesia (*see* Chapter XIX) is unsurpassed

Making the Incision —The curved scalpel, generally called a 'Syme's knife', is often recommended, but a straight blade is better Whatever knife is used, it should be very sharp The rule is that incisions should be made parallel to, and not across the direction of, structures which it is desired to avoid.

Fig 402 —A finger is introduced into the abscess cavity and is used to explore and when necessary break down loculi

Exploration of the Abscess Cavity —A finger is introduced into the abscess cavity When necessary, loculi are broken down in order that subsequent drainage may be facilitated (*Fig* 402)

Counter-openings —As a rule, abscesses, especially acute ones, must be opened where they point, but this is very often not the spot which would be chosen by the surgeon, who would prefer to make his opening at the most dependent part, this may necessitate the making of a *counter-opening* by passing a director through the sac from the upper pointing aperture to the bottom of the cavity, and cutting down upon the point of the instrument, so held that it can be felt there through the skin

Obtaining a Specimen for Bacteriological Examination —Before commencing the operation it is a good practice to have in readiness a sterile test tube so that a sample of pus can be collected

Hilton's Method —If important structures are likely to be encountered or injured, Hilton's method should be employed this consists in incising the tissues down to the deep fascia and inserting a director into the most prominent part of the swelling, or where fluctuation is most obvious, until the pus flows along the groove The opening is then enlarged with sinus forceps or Spencer Wells forceps, until a track of sufficient size has been established When once the opening has been made, it is usually unnecessary to do more than insert a drainage tube

Drainage —All acute abscesses require drainage, though the duration and form of this drainage vary in individual cases Generally a rubber tube of fair size is the best, but where the bleeding is profuse, or where the position of the abscess is unsuitable for tube drainage, vaseline gauze should be substituted In such cases care should be taken that the gauze is not tightly packed into the cavity

After-treatment —Irrigations of the cavity through the tube once or twice daily are of value, the tubes being gradually shortened as the cavity closes

Peroxide of hydrogen, though of undoubted value, must be used with caution When brought into contact with protein oxygen is given off, and if there is not a ready exit the gas so generated may force its way through the walls of the abscess into the cellular tissues

Drainage should not be too prolonged, since a tube is a source of irritation, sinuses are often caused by a too zealous adherence to the tube When the temperature has been normal for three days, when the discharge has become clear, it is time to withdraw the drain

Rest is an important factor in the healing of abscesses Neglect of this detail is another cause of troublesome sinuses The part should be immobilized as far as possible Splints, bandages, or whatever apparatus may be most suitable, should be applied

The 'Closed' Method of the After-treatment of Superficial Abscesses —When pus has been evacuated the area is covered with flexible adhesive plaster or a Viscopaste bandage, and, if necessary, a splint is applied When the discharge oozes through it is washed away with soap and water, but the bandage is not removed for a week, and nothing is applied over the bandage which might hinder free evaporation, the freer the evaporation the less the discharge When the abscesses occur in soft tissues, such as the neck or the buttock, and a large non-collapsible cavity results, the abscess cavity is packed with vaseline gauze before the Viscopaste bandage is applied It is necessary to remove the pack every five days After drying the skin with surgical spirit it is again covered up with Viscopaste bandage or in certain cases with flexible adhesive plaster

TREATMENT OF SOME SPECIAL ACUTE ABSCESSES

Deep Cervical Abscess —Early recognition of the presence of pus beneath the deeper fasciæ of the neck is of the highest importance, yet sometimes it is extremely difficult, the pus is so confined and so deep, and there is often so much general swelling, that fluctuation cannot be made out

Constitutional disturbance is generally great, and the temperature chart will be evidence of the formation of pus If a localized induration can be felt, make a 2-inch incision at the anterior border of the sternomastoid (*Fig* 403) Incise the deep cervical fascia and gently search with the finger and a blunt director for pus, having due regard to the great vessels

Suppurating Cervical Lymphatic Glands —In dealing with this common condition one can usually delay operation with safety and advantage until the centre of the swelling is soft, or until the overlying subcutaneous tissues become œdematous A comparatively small incision is made, and the abscess is opened by Hilton's method Tube drainage is employed

Abscess of the Breast —In cases of acute suppurative mastitis there is no occasion to hurry to open the breast Large magnesium sulphate fomentations are applied and the patient is given a dose of morphia, for in all probability she

has not had much sleep owing to the pain If she is feeding her child it must be weaned and the healthy breast emptied by a breast pump The milk secretion is minimized by giving saline aperients and atropine

The breasts are examined daily In a few cases, under the treatment outlined above, resolution will occur In the majority one will see the blush, tenderness, and induration become mainly confined to a quarter or, at the most, half the breast—usually the lower half *Fluctuation should not be awaited*, it is usually wise to wait until there is some semblance of localization

Fig 403 —Incision for opening a deep cervical abscess

Open Operation —The first incision is made in a line radiating from the nipple into that quadrant which is deemed most indurated (*Fig* 404) When necessary, counter-openings are made

The Closed Method of Treating Breast Abscesses —This method of treating breast abscesses offers certain advantages —

1 Secondary infection is largely avoided
2 The method is practically painless
3 It necessitates very little skilled nursing
4 Scar formation is reduced to a minimum

The Operation —Under gas or evipan anæsthesia a single incision ¾ in in length is made at the most dependent portion of the indurated area The finger is inserted and loculi of the abscess cavity are broken down A ½-in drainage tube is introduced into the cavity The edges of the wound are approximated snugly around the tube by a single silkworm-gut stitch, which passes also through the side of the tube, anchoring it into position The tube is cut off nearly flush with the skin Into the large tube is passed a small ¼-in drainage tube with a number of perforations near its distal end The small tube is then fastened to the large one by a fine silkworm-gut stitch, which also serves to close the hole snugly in the gauze about the tube The patient is now allowed to come out of the anæsthetic

Fig 404 —Incisions for opening an abscess of the breast mainly confined to the lower and outer quadrant.

Dressings —A liberal amount of fluffed up gauze is arranged over the vaseline-gauze-protected breast This in turn is covered by a large piece of oiled silk Through these layers is brought the *small* tube The whole is supported by a many tailed bandage, which encircles the upper abdomen, both breasts, and the opposite shoulder (*Fig* 405) The reader may be thinking that this is complicated and unnecessary, but the whole procedure is carried out in a very few

minutes if the simple requisites are got ready beforehand The boon of this method becomes apparent in the supreme simplicity of the after-treatment

After-treatment —The patient lies in bed in a comfortable semi-recumbent position Every four hours a measured quantity of Dakin's solution is injected down the tube (*Fig* 406) The overflow is automatically absorbed into the fluffed gauze If necessary, this instillation can be done by an unskilled nurse, or even by the patient herself The dressing is not disturbed for twenty-four hours At the end of that time the many-tailed bandage is loosened and the fluffed

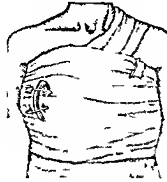


Fig 405 —Method of applying the overall many tailed bandage, and of fixing the end of the irrigating tube when not in use In practice the free end of the tube is wrapped up in a piece of gauze moistened with Dakin's solution.

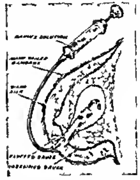


Fig 406 —Diagram illustrating the technique described in text. The amount of Dakin's solution to fill the abscess cavity has been ascertained at the time of operation This quantity is injected down the small tube every four hours The overflow runs out of the large tube and is absorbed by the gauze The layer of vaselined gauze protects the skin from the irritating effect of the fluid

gauze is changed Providing the temperature chart is satisfactory, and the patient does not complain of discomfort, the inner dressing of vaseline gauze and the tubes are not touched This labour-saving, pain-sparing regime is followed until the fourth or fifth day, when the surgeon himself removes all dressings and usually takes out the tubes

More Remote After-treatment —A fresh piece of vaseline gauze, which is so essential in preventing cutaneous erosion by the Dakin's solution, is applied By means of a rubber catheter the abscess cavity is washed out with the solution twice a day It will not be long before irrigation need be undertaken but once a day By approximately the tenth day the wound presents a healthy, granulating appearance, but there appears from time to time some seropurulent discharge, probably admixed with a little leakage of secreted milk The latter is washed away with Dakin's solution diluted with saline to one half or quarter strength The time has now arrived for the vaseline gauze square to be discarded It is usually advisable to keep a wisp of vaseline impregnated gauze in the mouth of the wound for a day or two

Convalescence —The only dressing now required is a piece of dry folded gauze over the wound, kept in place by adhesive plaster The patient can get up, wearing an ordinary brassière for support There is always a considerable indurated area in the breast at this period, and it persists for some time

Axillary Abscess.—Abscesses of the axilla must be opened promptly, for the pus tends to extend along the path of the nerve-trunks into the neck The site of the incision will depend upon the situation of the pus *In acute abscesses pus usually lies under the pectoralis major*

Abduct the arm fully Make an incision quite 2 in long just below the fold of the pectoralis major (*Fig* 407)

Hilton's Directions for Opening a Deep Abscess in the Axilla —Cut through the skin, cellular tissue, and fascia of the axilla about half an inch behind the axillary edge of the great pectoral muscle At that part we meet with no large blood vessel Then push a grooved director upwards into the swelling in the axilla, if you watch the groove in the director, a little stream of pus will show itself Take a blunt pair of forceps and run the closed blades along the groove in the director into the swelling Now open the handles and so tear open the abscess

In late cases, when the whole axilla is merely a bag of pus, an incision into the lower part of the middle of the space will be found convenient

Suppurating Glands of the Groin (syn Bubo) —This term is applied to all glandular or periglandular abscesses of the femoral and inguinal glands The exciting causes are various In children, a sore heel or inflamed scratch on the leg often produces suppuration in the femoral group of glands

Fig 407 —Opening a deep-seated axillary abscess

In adults, the most frequent causes of buboes are gonorrhœa and soft chancres These buboes are almost always abscesses *around* the glands, which run a subacute burrowing course

Buboes should always be opened early, from the tendency they have to form long fistulous tracks in the cellular tissues A vertical incision is made, and the abscess cavity kept open, so that it may heal from the bottom Many buboes, particularly those associated with soft sores, run such a chronic course that some surgeons prefer to dissect out the affected glands After the glands have been removed, every bleeding point is ligatured and the interior of the wound is sprinkled with sulphonamide powder The wound is closed without drainage and firm pressure applied by means of strips of flexible adhesive plaster

Popliteal Abscess —This arises most commonly from an infection of the lymphatic glands of the popliteal space, via the lymphatics, from a sore on the heel

A free incision is made on the lateral aspect of the space parallel to the tendon of the biceps Pus is evacuated and the space drained by a corrugated rubber strip or a length of vaseline gauze, a rigid rubber tube should not be used in this situation

Ischiorectal Abscess —In no circumstance should pointing of an ischiorectal abscess be awaited A brawny induration about the base of the ischiorectal fossa is sufficient indication that an incision is necessary With the patient in the lithotomy position an ample cruciate incision is made over the base of the fossa (*Fig* 408) The incision is enlarged until it extends from the top to the bottom of the abscess, and from side to side The triangular flaps are lifted up and each is excised along its base (*Fig* 409) When the medial flaps are excised care is needed to avoid injuring the sphincter muscle The skin is excised to a point just within the anal canal The abscess is explored with the finger and any septa broken down Ligatures are avoided as far as possible

When the abscess is bilateral both sides should be opened up by the technique described, together with the communicating track A flat moist dressing soaked in flavine or a saturated solution of magnesium sulphate is applied to the wound

Fig 408 —The incision for ischiorectal abscess

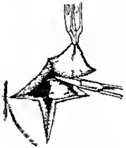


Fig 409 —The resulting four flaps are dissected free and removed as shown

The cavity is not packed Hip baths can be commenced on the following day in most cases No plugging is used in the after-treatment

Alveolar Abscess.—*See* p 446

Retropharyngeal Abscess.—*See* p 409

Peritonsillar Abscess.—*See* p 408

Psoas Abscess.—*See* p 343

CHAPTER LII

CARBUNCLES AND BED-SORES

By McNeill Love

CARBUNCLES

Local Treatment.—In the earliest stages this consists in an effort to prevent suppuration Thus the area of initial induration should be treated by Klapp's suction bell, applied for five minutes three or four times a day The passive hyperæmia so induced occasionally aborts the process and resolution follows In the early stages of a carbuncle the application of an elastic plaster may abort suppuration The plaster acts as a splint, and if the resistance of the patient can be raised to an adequate level the local inflammation may then resolve A patient who is threatened with a carbuncle of the face or lip must be ordered to remain indoors until localization has occurred, so that he can be under constant treatment and skilled supervision Carbuncles in this situation are fraught with danger of thrombosis of the facial vein, and extension to the cavernous sinus, which is almost invariably fatal Also the patient must be warned not to squeeze the carbuncle in the hope of evacuating pus, as squeezing any infected zone devitalizes the traumatized tissues and encourages the spread of infected exudate

In the early stages, and sometimes later, superficial X rays are very comforting and exert a beneficial effect They are applied in a half erythema dose (approximately 200 r units), which is repeated at the end of the week. Infra-red radiation, twice daily for a period of twenty minutes, is a useful adjunct to other methods of treatment

When suppuration is evident, local treatment is directed towards limiting the spread of infection Various compresses are used, one of the most efficient being gamgee soaked in a hot solution of hypertonic saline or a 10 per cent solution of sodium sulphate This is covered with jaconet and a voluminous cotton wool dressing A hot-water bottle or electric pad assists in maintaining the temperature Unless dressings can be changed at frequent intervals a paste of glycerin and magnesium sulphate is more efficacious The surrounding skin should be protected with some antiseptic preparation such as ung hydrarg nitrat dil or Dettol cream so as to discourage auto-inoculation

In spite of precautions the surrounding skin is apt to become sodden and infected if moist dressings are used, therefore some surgeons favour a dehydrating application such as gentian violet, 1 per cent in equal parts of spirit and water, or 'Bonney's blue', which is composed of 1 per cent methyl violet and 1 per cent brilliant green in equal parts of industrial methylated spirit and water These preparations are applied thrice daily, and the affected area is exposed to the air, uncovered by any dressing

A method of walling off the infection consists in the injection of blood around affected areas Gas and oxygen or evipan is administered, and 20 c c of blood is withdrawn from the patient into a syringe containing 2 c c of 2 per cent sodium

citrate The blood is injected at various points around the carbuncle, each injection commencing in the subcutaneous tissue and ending in the necrotic area A clean needle should be used for each injection in order to prevent auto-infection Autogenous blood circuminjection is a procedure which should be adopted more frequently, particularly in the early stages

The practice of excising a carbuncle, formerly much in vogue, is now superseded by conservative measures, with the exception that excision is very occasionally indicated if necrosis of tissue spreads rapidly in spite of treatment, in which case it somewhat resembles cancrum oris In an endeavour to limit the spread of infection either the whole carbuncle, or more commonly the edge which is extending, is freely excised, and the resulting wound is packed with gauze soaked in 1–1000 flavine solution

General Treatment.—This deserves careful consideration, as the progress largely depends on the general resistance of the patient If the patient is a diabetic, suitable doses of insulin and an appropriate diet are prescribed 'Tonics' are administered, such as manganese, iron, or quinine, with due regard to the enfeebled digestion of old people Intravenous or intramuscular injections of collosol manganese are sometimes useful Stimulants are advisable, and are given in any form palatable to the patient The old-fashioned treatment of a bottle of port a day has much to recommend it in debilitated subjects The diet must be appetizing, and good nursing may turn the scale in the favour of a debilitated patient Fresh fruits and vegetables are desirable in order to supply an ample quantity of vitamins Cakes, sugar, jams, and sweets are reduced to a minimum, as patients do better on a low carbohydrate diet An ample fluid intake is important Blood examination may reveal an unsuspected anæmia, which may even justify a blood transfusion

In some cases good results are obtained from vaccines The initial dose is 100 millions of stock staphylococcal vaccine, followed by 250 millions four days later The oral administration of horse-serum is recommended by some surgeons Sulphur and yeast (vitamin B) are supposed to have a beneficial effect, but the results are very doubtful and these substances are now but rarely prescribed With regard to chemotherapy, sulphathiazole represents a distinct advance in the treatment of carbuncles (*see* Chapter L)

BED-SORES

There are four factors which encourage the formation and development of a bed-sore these are pressure, trauma, malnutrition, and maceration of the skin

Prevention —

Pressure —Bed sores almost always occur over bony prominences, notably the sacrum, coccyx, scapulæ, elbows, and heels, and, if the patient spends much time on his side, the great trochanters Frequent change of posture is the obvious method of redistributing pressure A healthy person normally changes his posture at frequent intervals, especially if lying on a hard surface, and the nurse should arrange that a helpless patient lies on alternate sides for an hour or so daily, at the same time keeping a watchful eye on the skin over the great trochanters Redistribution of pressure can be obtained by the use of a water bed Boards should be placed beneath the mattress so as to support the water-bed, which is half filled with water at a temperature of 100° F The water-bed is covered with a blanket, mackintosh, and sheet, with a draw-mackintosh and draw sheet under the buttocks Even distribution of pressure is best obtained if the patient is nursed on a sponge rubber type of mattress This adds to his comfort and the mattress is very durable. Air cushions are valuable in some cases, especially for protection of the heels In this connexion much comfort will be derived from a

pillow under the knees (commonly known as a 'donkey'), which allows some pressure to be borne by the back of the thighs and calves, and the flexion of the knees allows pressure to be borne by the under surface of the heels rather than by the more susceptible posterior portion. Cotton wool 'nests', or rings cut from a sheet of sorbo rubber form useful protections for the bony prominences of the back and trochanters. In order to increase the area available for pressure bearing, the normal curve of the spine in the lumbar region should be utilized. An air cushion or soft pillow should be inserted beneath the hollow of the back, so that the skin in this region shares in the burden of pressure bearing. Air cushions of too small a size are apt to cause œdema, and air cushions which are horse shoe in shape (Dunlopillo) are safer than circular ones.

Trauma.—Injury to the skin, unless already present, is always preventable. Common causes, which should be avoided, include wrinkling of the draw sheet, which must be kept taut, or maladjustment of such supports as rings or pads, which are utilized to distribute pressure. An abrasion due to an overlain biscuit crumb is a traditional cause of a bed sore. Small pieces of grit in the dusting powder are apt to cause abrasions of the skin. If the nurse rubs the powder into the skin at all vigorously, minute excoriations are likely to occur, and if other factors are favourable a sore may result. Therefore only powders which are carefully refined and of good quality should be used. Damage to the skin is sometimes due to insertion of a bed pan, or to vigorous removal of an abdominal binder without raising the patient from the bed. Protection of any specially vulnerable areas by means of Elastoplast is of great value. The plaster must not be stretched before application, and is applied where bed sores are to be expected.

Malnutrition of the Skin.—Constant attention by the nursing staff is necessary to maintain the nutrition of the skin at the highest possible level. Once a day, or more often if the condition of the patient permits, the nurse or nurses should roll the patient on to his side and attend to the back, which is sponged, dried, rubbed with astringent and finally powdered. Most nursing schools use their own favourite preparation, and among those commonly used may be mentioned brandy, eau-de-Cologne, and varying strengths of alcohol, usually in the form of surgical spirit. It must be mentioned that methylated spirit is definitely harmful, as it contains substances which are liable to irritate the skin. After the final rubbing the skin is dusted with some powder, such as dermatol (bismuth subgallate), talcum powder, or equal parts of boric acid, zinc oxide, and starch, carefully prepared so as to exclude grit. If the patient is incontinent, the treatment outlined above may be required several times a day. In the case of cord injuries, anæsthesia, which permits painless damage to the skin, is a more potent factor in the production of bed sores than trophic or nutritional disturbances.

Maceration.—Maceration of the skin is liable to result from sweat, urine, fæces, or pus. Sodden skin is particularly vulnerable, and every effort must be made to keep the skin as dry as possible. In the case of spinal injuries, incontinence of urine in the male is dealt with by keeping a urinal in position, while in the female, or in cases associated with discharging wounds, absorbent material and mackintoshes can be arranged so as to protect the adjacent skin. In the case of a male suffering from a cord injury with overflow, soiling by urine can be prevented by the following simple appliance, recommended by G. M. Astley, of Philadelphia. A piece of rubber tubing is secured by a ligature or rubber band to a perforated condom. The condom is applied to the penis and acts as an efficient urinary conductor, and it is unaffected by movements of the patient.

Local Treatment.—Bed sores occur in one of three more or less distinct stages: threatened bed sore, inevitable bed sore, and actual ulcer. The last stage varies from superficial ulceration to extensive destruction of skin, fasciæ, muscles, ligaments, and even bone. It is a remarkable and fortunate fact that even when an ulcer has reached ghastly dimensions the patient is often quite unaware of the extensive destruction of his tissues.

Stage I. Threatened Bed sore.—Erythema of the skin, which disappears on pressure, is the earliest indication that a bed sore is impending. At this stage moist dressings or ointments are contra indicated, and reliance is placed on the prophylactic measures already outlined, combined with some preparation which will harden the skin if it is unduly soft. For this purpose the application of 5 per cent silver nitrate in distilled water is useful. Another preparation which is

recommended at this early stage is equal parts of tincture of catechu and liquor plumbi subacetatis

If the skin is harsh or dry, as over the heels or elbows, then some protective covering may prevent the development of a threatened bed-sore For this purpose flexible adhesive plaster is excellent, provided that it is not stretched before application and that it is applied smoothly

Stage II Inevitable Bed-sore—Ulceration is imminent when redness and congestion appear and are unaffected by pressure This indicates capillary thrombosis, and inevitable necrosis Treatment now resolves itself into minimizing the amount of destruction of tissues, and general principles of treatment must be utilized to the full In most cases the best form of local treatment is the tannic acid spray used as for burns A freshly prepared 5 per cent solution in distilled water is sprayed on at hourly intervals, and the affected surface is dried by means of an electric hair-drier or by exposure to dry heat from electric lights suspended from a cradle A tough and adherent coagulum forms after about twenty applications

Stage III Ulceration—This final stage of bed sores presents an anxious and constant problem to those who are responsible for the patient's welfare—anxious, because bed-sores are apt to spread in an alarming manner, and toxic absorption adds to the other burdens which the patient has to bear, and constant, because treatment may require almost daily variation according to the progress of the ulcer As a general principle, when actual ulceration is present, ointment and other greasy or oily preparations are unsuitable

In early cases of ulceration treatment by flexible adhesive plaster is always worth while Two pieces of the plaster are applied, so as to cover the ulcer and the surrounding skin If the sore is of greater diameter than the width of the bandage, two pieces are applied side by side, and held together by other pieces placed at right angles The flexible adhesive plaster should not be stretched before it is applied, and is left in position until it is loosened by the discharge, which may be at any time from one to several days The loose plaster is removed, the ulcer is cleansed with sterile gauze, and the plaster then reapplied This process is repeated as often as necessary The virtues of this method of treatment are that granulations are uninjured by frequent dressings, and possibly the retained discharge possesses a proteolytic power which liquefies dead tissue Thus the flexible adhesive plaster treatment of bed sores resembles Winnett Orr's method in dealing with acute osteomyelitis A further advantage of the plaster treatment is its simplicity, and that no very skilled nursing is needed

Occasionally these protective measures fail, especially in acute cases of bed-sores associated with a spinal lesion Extending bed sores, when protection by plaster has failed, are the only variety which call for the use of moist applications Various antiseptics are suitable, such as flavine, eusol, or dettol If surrounding tissues are inflamed, an occasional boric fomentation is advisable, but care must be taken to avoid maceration of the skin It is wise to change antiseptics every few days, especially if local improvement is disappointing As in the case of any infected wound, organisms appear to become immune to any one antiseptic after prolonged use

When the stage of healing is reached, and discharge becomes serous, the application of 10 per cent ichthyol in glycerin usually expedites healing in a very satisfactory manner, in fact, this preparation gives good results with most varieties of infected wounds after the acute inflammation has subsided At a

later stage more stimulating dressings are indicated, so as to encourage growth of epithelium, and red lotion or equal parts of zinc oxide and resin ointment should be applied Infra-red radiation twice daily often changes indolence into activity The question as to the advisability of skin-grafting is decided on general principles

General Treatment.—This is important, as the recuperative powers of the skin, as well as other tissues, depend to some extent on the nutrition and well being of the patient Fresh air, bright surroundings, adequate nourishment, and suitable medicines are all important Insulin is worthy of consideration, even in non-diabetic patients, and it is remarkable how in some indolent sores, healing commences and continues two or three days after the initial injection. The usual dose is 5–10 units three times a day This method of treatment does not seem to be widely recognized, and is always worth a trial when local measures are meeting with little success

CHAPTER LIII

THE TREATMENT OF INFECTIONS OF THE HAND

By Hamilton Bailey

Pre-operative Treatment.—*In* the preliminary stages (i e, when it is hoped that an infection may be aborted, or when it is as yet impossible to decide the location of the pus), a Bier's bandage is applied to the arm (*Fig* 410) in such a way as to produce congestion, but there should be no blueness or duskiness If pain is increased by the bandage, the bandage is too tight The bandage is left on for from 12 to 24 hours, during which time sulphanilamide is prescribed

Fig 410 —Bier's bandage applied to the upper arm there should be no blueness or swelling of the forearm

INFECTION OF THE TERMINAL PULP COMPARTMENT

The pulps of the fingers and thumb are subjected to more pricks, and therefore infections, than any other part of the body Nature has provided in this situation a closed fascial compartment which extends from the tip of the digit to the level of the epiphysial line of the terminal phalanx (*Fig* 411)

Treatment —If treated correctly, infection of the terminal pulp compartment is seldom serious When tenderness is most marked over the pulp compartment, it is permissible to wait for localization of pus When the pulp feels indurated is the time to open it In the whole realm of surgery there is not a more heinous offence than to incise downwards through the pulp into the tendon-sheath *The incision must on no account extend in a proximal direction farther than half an inch from the terminal flexor crease*

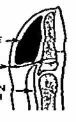


Fig 411.—The terminal pulp compartment.

The Transfixion Operation—A tourniquet in the shape of a rubber catheter is placed around the base of the digit Keeping half an inch distal to the terminal flexion crease, two incisions are made, one on each side, 2 mm in front of the nail edge The knife, which should be a narrow-bladed one, is thrust through the pulp space from one incision to the other with its blade directed towards the finger-tip (*Fig* 412) If pus is not found, it probably lies more superficially in the pulp space, so with the scalpel in the transfixion incision, cuts are made forward into the pulp, care being taken not to perforate the skin. A through-and-through drain is left in position and the tourniquet is removed

The best dressing is a Viscopaste bandage, and a wooden spatula makes an excellent dorsal splint. The patient is given an arm sling and told to report next day. If a Viscopaste bandage has been used there is no need to disturb the dressing until the third or fourth day, when the drain is removed. A flexible

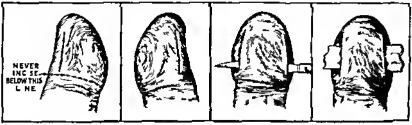


Fig 412.—The transfixion operation for terminal pulp space infection

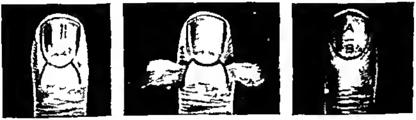
adhesive plaster bandage is then applied directly to the finger and is changed every third or fourth day, or oftener if the discharge is profuse.

Complication.—If the wound has not healed within fourteen days a radiograph should be taken. If necrosis is proceeding, the purulent discharge will continue until the diaphysis can be picked out of the wound as a sequestrum. A weekly X-ray examination will aid in determining when the sequestrum has separated.

PARONYCHIA

Organisms gain entrance through a hang nail, and the tissues about the base of the nail become inflamed. Suppuration follows frequently, and in 63 per cent of cases pus accumulates under the nail, as well as beneath the cuticle.

TREATMENT.—Early operation is indicated. Lateral incisions are made (*Fig* 413, *a*), and the flap is turned back. In order to keep the flap elevated a wisp of gauze soaked in paraffin is inserted under the flap (*Fig* 413, *b*). In very early cases one lateral incision may be sufficient, but it is wise to err on the side



a *b* *c*

Fig 413.—Treatment of paronychia. *a* Incisions for turning back the flap. *b* A wisp of gauze soaked in paraffin is used to maintain elevation of the flap. *c* When there is pus under the nail the portion B is removed and the portion A is retained.

of radicalism. A Viscopaste dressing will be found most satisfactory. On the third or fourth day the wisp of gauze is removed and the flap allowed to fall back. A dressing every third or fourth day is all that is required if this method is employed.

When there is Pus under the Nail.—In addition to the above, the base of the nail (*Fig* 413, *c*) should be removed in the following way: after the flap has

been turned down, one blade of a pair of scissors is inserted under the base of the nail, and the portion B is removed It is unnecessary and harmful to remove A unless it is detached The portion A will exercise a protective action until the new nail grows up and forces it away, a process which takes about two months

SERIOUS INFECTIONS OF THE HAND

Serious infections of the hand fall particularly into three categories (1) Lymphangitis, (2) Suppurative tenosynovitis, (3) Fascial space infections The third group is often a sequel of the second

LYMPHANGITIS

Organisms, almost always streptococci, gain entrance through an abrasion which may be minute A portion of the hand immediately adjacent becomes swollen and painful, and there is often considerable elevation of the temperature Later, red streaks, so characteristic of lymphangitis, can be seen coursing up the arm It is of cardinal *importance to distinguish lymphangitis* from suppurative tenosynovitis and fascial space infections The two latter conditions require urgent operation, while in lymphangitis, at any rate in its early stages, incision is highly mischievous

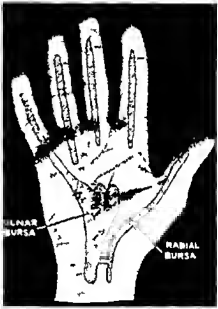


Fig 414.—The flexor tendon sheaths of the hand

SUPPURATIVE TENOSYNOVITIS

It is of fundamental importance to be able to visualize the surface anatomy of the tendon-sheaths and their connexions (*Fig* 414)

The essential signs of an infected *digital flexor tendon sheath are* (1) Swelling of the finger, (2) Flexion of the finger with exquisite pain on extension, (3) Tenderness, maximum over the infected sheath

The point of maximum tenderness is found by palpating systematically with some blunt pointed instrument A burnt match-stalk with the loose charcoal removed answers the purpose admirably

The greatest swelling does not necessarily indicate the position of the pus Frequently there is œdema (swelling) of the dorsum, whereas in 90 per cent of cases the pus lies on the palmar aspect Œdema gives rise to pitting on pressure If pus is present, induration of the tissues can be felt

Serious as it is at all times, suppurative tenosynovitis becomes a lesion of the first magnitude when the tendon-sheath of the thumb or the little finger is involved In the case of the little finger the *ulnar bursa* (the palmar bursa of British anatomy) will almost certainly be implicated quickly If the infection is primarily in the flexor tendon-sheath of the thumb, the *radial bursa* (syn sheath of the flexor pollicis longus) must be simultaneously infected along its whole course—that is, right up under the anterior annular ligament to above the wrist (*see Fig* 414)

Nor is this the whole gloomy story. If the tendon sheath of either the thumb or the little finger becomes infected, there is an 80 per cent chance that within forty-eight hours there will be total infection of both the ulnar and radial bursæ, for, as shown in *Fig* 414, there is usually an intercommunicating channel between them.

Signs of Involvement of the Radial Bursa.—

1. Flexion of distal phalanx of the thumb with rigidity.
2. Swelling just above the anterior annular ligament.
3. Tenderness over the flexor pollicis longus sheath.

Signs of Involvement of the Ulnar Bursa.—

1. Œdema of the hand, especially the dorsum.
2. Fullness of the palm, but the concavity is still present.
3. Fullness immediately above the anterior annular ligament.
4. Kanavel's sign—a point of maximum tenderness over that part of the ulnar bursa lying between flexion creases (*see Fig* 414).

General Principles in the Treatment of Suppurative Tenosynovitis.— Effective drainage must be instituted at the earliest possible moment. Gas-and-oxygen or evipan anæsthesia is employed. The hand is raised for three minutes and a *tourniquet is applied to the forearm*. The hand is placed upon a small table and the surgeon sits down to operate. The infected tendon-sheath should be opened widely, not exactly in the middle line, but somewhat to one side of it. The middle line is avoided in order to prevent, as far as possible, prolapse of the tendon during the later stages of treatment. In early streptococcal cases there is very little pus within the theca, but the synovial fluid is slightly opalescent or tinged with blood.

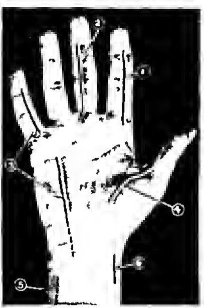


Fig 415.—A symposium of incisions for draining infected flexor tendon sheaths. 1 Usual incision for opening an infected tendon sheath. 2, When a lumbrical canal is infected in addition, the incision is prolonged into the appropriate web space. 3 Incisions for opening an infected ulnar bursa. 4 Incision for opening an infected radial bursa. 5 Incision for opening all infections of the forearm from the hand. 6 Counter incision used in the case of infection of the forearm from the radial bursa.

A Consideration of Individual Tendon-sheaths from the Point of View of Treatment.—

The Index Finger.—The sheath should be opened somewhat to the radial side (*Fig* 415, 1), unless it has been shown at the clinical examination that the lumbrical canal between the index and middle finger is involved. In any case, as soon as the sheath has been opened pressure should be exerted over the second lumbrical canal and over the thenar space; if pus wells out of either of these spaces, it must be drained.

The Middle Finger.—One must decide upon which side to open the sheath so as to be able to drain the appropriate lumbrical canal by a suitable short extension. In doubtful cases the ulnar side is chosen (*Fig* 415, 2). As soon as the sheath is opened, pressure is exerted over the mid-palmar space, and if pus wells out the space should be drained.

The Ring Finger—The same principles govern this finger, with the exception that when in doubt the radial side is chosen

The Little Finger—The sheath is opened (*Fig* 415, 3), pressure is then exerted over the ulnar bursa If pus exudes, the ulnar bursa must be opened

Drainage of the Ulnar Bursa—The method is important The hypothenar eminence is inspected, the incision runs down its centre rather nearer the radial side It begins at the distal flexor crease, and ends just distal to the first crease encountered at the wrist (*Fig* 415, 3) A pad of œdematous fat bulges into the wound, this is dissected away A director is then passed from the sheath of the little finger into the bursa, which is opened along its length as near to the ulnar side as possible When the anterior annular ligament is reached, pressure is exerted above the wrist, pus is usually present here It is advisable to divide the anterior annular ligament *The forearm must be drained* as described below As a general rule, if the infection has been present more than forty eight hours, there should be no hesitation in opening the radial bursa, which is so often implicated

The Thumb—The sheath, opened somewhat on its radial side, is followed through the muscular masses of the thenar eminence (*Fig* 415, 4) The tendon lies nearer the palm than one is inclined to think The dissection is carried down towards the wrist until a point *a thumb's breadth distal to the anterior annular ligament* is reached The dissection then ceases abruptly, for the motor nerve to the thenar muscle crosses the sheath between this point and the anterior annular ligament The forearm must be drained as described below Once more, as a general rule, if the infection has been present for more than forty-eight hours, there should be no hesitation in opening the ulnar bursa, which is so often infected as well

Involvement of the Forearm from the Hand.—The spread of pus from the hand to the forearm occurs along the plane between the flexor profundus and the pronator quadratus It is in this deep plane that pus first tracks up the arm, and only late in the course of the disease does it become more superficial Utilizing this knowledge, drainage of the forearm in infections from the hand can be carried out with precision The styloid process of the ulna is palpated The incision commences 1½ in above this point upon the flexor surface of the ulna The incision is at least 2 in long (*Fig* 416) and it passes deeply right down to the periosteum A hæmostat is thrust across the flexor surface beneath the flexor tendons and the jaws of the forceps are opened Next the proximal extremity of the infected bursa is ruptured thoroughly into the space beneath the flexor tendons In the case of a radial bursa infection, a counter-incision is made upon the radial side (*Fig* 416) If the infection has extended far up the forearm, a second incision, as shown in *Fig* 416, will be required

Fig 416—Incisions for draining the space beneath the flexor tendons

FASCIAL SPACE INFECTIONS

The Thenar Space.—

Boundaries of the Thenar Space—
On the palmar aspect The palmar fascia, which in this situation is thin and elastic
On the dorsal surface The adductor transversus pollicis.

On the ulnar side A septum of strong fascia attached to the middle metacarpal bone This septum separates the thenar from the middle palmar space (*Fig* 417).

The thenar space may become infected directly from a wound More frequently it is involved by the bursting of a pus filled flexor tendon sheath of the index finger Infections of the thenar fascial space produce much swelling There is ballooning of the thenar eminence

Fig 417 —The thenar and middle palmar fascial spaces The three diverticula from the middle palmar space are the lumbrical canals

Fig 418 —Incision for draining the thenar space

TREATMENT —Operation is imperative, the danger of delay is great The results of opening a non infected space are minimal

The incision is made on the dorsum, and is shown in *Fig* 418 The incision passes just to the radial side of the metacarpal of the index finger A hæmostat is passed into the space and opened This gives perfect drainage and no tube or other drainage material is necessary

It is, of course, essential to attend to a suppurative tenosynovitis if such is present

The Middle Palmar Space —

Boundaries of the Middle Palmar Space —

On the palmar aspect Fascia separating it from the flexor tendons of the middle, ring, and little fingers, with their lumbricals

On the dorsal aspect Fibrous tissue separating it from the interosseous muscles of the third and fourth spaces

On the radial aspect That fascial septum attached to the middle metacarpal which separates it from the thenar space (*see Fig* 417)

The middle palmar space has three diverticula—the lumbrical canals of the middle, ring, and little fingers It is overlapped on the ulnar side by the ulnar bursa, therefore, *it must never be incised directly from the palm,* otherwise the ulnar bursa will become infected, a very grave matter

The middle palmar space may become infected from rupture of the tendon-sheath of the middle, ring, or little finger It can also be infected directly by penetrating wounds of the palm or from osteomyelitis of the middle or ring metacarpal bones

Obliteration of the concavity of the palm, and a slight bulging thereof, is almost pathognomonic of an infection of the middle palmar space There is no point of maximum tenderness

TREATMENT —Efficient drainage of the middle palmar space may be secured via a lumbrical canal This is effected by opening the web between the ring and middle fingers, or the ring and little fingers If a choice exists, the former is chosen (*Fig* 419) The fingers are spread The incision begins on the dorsum, and passes over the web on to the palm, *but never beyond the distal flexor crease* The incision is deepened Pressure is exerted over the middle palmar space If pus wells up, a grooved director is inserted along the lumbrical canal The incision is extended until the web is split completely, almost to the distal flexor crease A closed hæmostat is now inserted under the flexor tendon, and its jaws are opened widely No drainage material is necessary

An abscess of the middle palmar space is usually secondary to suppurative tenosynovitis of the middle or ring finger, which of course will require appropriate attention

Fig 419 —Incision for draining the middle palmar space

THE 'DRY' AFTER-TREATMENT OF SERIOUSLY INFECTED HANDS

Soaking infected hands in hot baths and applying fomentations "as hot as can be borne" are methods of pre- and post-operative treatment which are so ingrained in the medical and nursing professions that it will take time for them to be supplanted

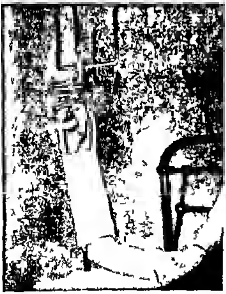


Fig 420 —The bandaged arm suspended from an irrigator stand

Having had experience of both the 'wet' and the 'dry' methods, I am certain that the latter is the correct one The disadvantages of the 'wet' method are as follows —

a It is extremely painful

b General swelling and tenderness of the hand due to the hot applications mask localized swelling and tenderness due to extension of the infected process, consequently, an all important accurate diagnosis of the location of the pus is often delayed unduly

c The hot-water treatment causes scalding, which, in addition to causing pain, predisposes to superficial inflammation

d Sodden, swollen tissues tend to narrow exits through which pus can escape

Technique of the 'Dry' Method. —For purposes of description a case of suppurative tenosynovitis will be taken After adequate drainage has been effected, a wisp of vaseline gauze is inserted in the lower end of the incision A piece of gamgee having been wrapped around the forearm, a length of Cramer wire is bandaged firmly to the dorsal aspect of the forearm A suitable piece of sorbo sponge is placed between the Cramer wire and the dorsum of the hand The incised finger is encased in a Viscopaste bandage

without fixing it to the splint, but as the bandage reaches the base of the finger it is carried around the splint and the palm The sound fingers are lightly bandaged to the splint in order to extend them The patient having been transferred to bed, the arm is elevated by suspending the end of the Cramer wire from an irrigator stand (*Fig* 420) Sulphonamide therapy is instituted The nursing instruenons are that if the patient is comfortable and the temperature falling, neither should the dressing be disturbed nor the position of the arm altered for 48 hours On the third or fourth day the dressing is changed and a Viscopaste bandage re-applied Each day the flexed, uninfected fingers are bandaged back a little more on to the Cramer wire, until they are completely extended While the treatment is essentially 'dry' this is not a fetish. About the fourth day the vaseline drain is removed and the hand put in an antiseptic bath for five minutes If there are sloughs present, the wound is irrigated The hand is then dried and the splint, etc, re-applied The arm is kept elevated for 14 to 20 days For about 2 hours each day it is lowered, and during this period the bandage is undone and the patient performs finger exercises under infra-red rays

In a very few instances the progress under the 'dry' treatment is unsatisfactory In such cases it can be changed to what is known as 'rotation' dressings for about 48 hours With the hand still immobilized, every 4 hours the following moist dressings are applied in turn (1) Eusol (normal strength), (2) Hydrogen peroxide (10 per cent), (3) Magnesium sulphate (5 per cent), (4) Normal saline The 'dry' treatment is then recommenced

CHAPTER LIV

THE TREATMENT OF VARICOSE VEINS AND ULCERS

By J B Oldham

VARICOSE VEINS

There are three forms of treatment for varicose veins (1) Palliative, (2) Injection of sclerosing solutions, and (3) Simultaneous ligature and injection of the saphenous vein Each of these methods has definite indications, contra indications, and limitations Frequently a combination of the methods is essential for success

Selection of Cases—Before commencing treatment, it is essential to deter mine (1) the *competency of the valves in the veins of the legs*, (2) *the patency of* the deep veins, and (3) the efficiency of the arterial supply of the limb The last of these points is settled by noting the pulsation in the dorsalis pedis and posterior tibial arteries, the other two are determined by the following tests —

Trendelenburg's Test—The patient lies down on a couch, the leg is raised and *the varicosities are stroked towards the groin until they are empty and collapsed* Then the thumb is pressed over the termination of the internal saphenous vein in the groin and the patient stands up, the pressure being maintained The pressure of the thumb is now removed, *if the varicosities fill immediately from above*, the valves at the upper end of the saphenous vein are defective, and combined ligature and injection will be needed If, however, the vessels only fill slowly and from below, the valves are sound, and *injections alone will be sufficient*

The test is repeated, but this time the pressure of the thumb is maintained, and the vessels are watched while the patient is standing, if they refill within thirty seconds, *the valves in the communicating veins* between the saphenous vein and the deep veins of the thigh are defective, and the saphenous vein must be ligatured below the com municating vein as well as in the groin The level at which it is necessary to ligature *the saphenous vein in order to control the reflux from the communicating veins*, can be determined by repeating the test with the thumb pressure applied lower and lower on the saphenous vein until a level is reached at which there is no longer any backflow

The competence of the valve at the upper end of the external saphenous vein can be tested in the same way, pressure being applied over the upper end of the dilated vein in the popliteal space

Tourniquet Test—In the *tourniquet test of Ochsner and Mahorner* the veins are watched, first with the patient standing, and then after walking A tourniquet is next applied at the top of the thigh, just tight enough to obliterate the superficial veins, and *once more the patient walks Improvement indicates defective valves at the junction* of the internal saphenous vein with the femoral vein, no change means that the valves are competent, and if the veins become larger and turgid, we have evidence that the deep veins are obliterated The test is repeated with the tourniquet at the middle of the thigh and then just above the knee If any further improvement is noted, the valves in the deep communicating veins are defective, and it will be necessary to ligature the saphenous vein, not only in the groin, but also immediately below the level at which the maximum improvement is obtained

PALLIATIVE TREATMENT

Palliative treatment should be given in all cases where active treatment is contra-indicated, it is also an essential adjuvant to the other forms of treatment and should be continued *for a long time after an apparent cure* has been obtained

The various factors which conduce to varicose veins and ulcers should be explained to the patient and every effort made to avoid constipation, prolonged standing, tight garters, and obesity

Except in cases with peripheral arterial disease, some form of support is advisable If there is no œdema, a crepe bandage, put on before rising and applied from the toes to above the knee, will be sufficient. In more severe cases, an elastic stocking may relieve symptoms, but if considerable œdema is present, a flexible adhesive or Viscopaste bandage will be needed

INJECTION TREATMENT

Injection treatment alone is indicated in cases in which there is no incompetence of the valves It may, too, be used in cases in which operative treatment is indicated but refused, and it is frequently needed to complete the sclerosis of any varicosities that may remain after operative treatment

Contra-indications —

1 *Severe Debilitating Diseases* such as diabetes, renal disease, and heart failure, should be under control before starting active treatment of the veins

2 *Severe Impairment of the Arterial Blood supply*, as shown by absence of pulsation in the dorsalis pedis or posterior tibial arteries

3 *Active Phlebitis* —No injection should be given in the presence of active phlebitis, nor for at least three months after the inflammation has settled, and even then the dose should be smaller than usual.

4 *Pregnancy* is no longer considered a definite contra indication, but, as patients are liable to blame the injections if they have a miscarriage, a phlegmasia, or any other complication of pregnancy, it is as well to postpone active treatment until after the confinement

5 *Occlusion of the Deep Veins* —There is generally a history suggesting that the deep veins have thrombosed, such as a swollen leg after typhoid fever, pneumonia, an operation, or confinement The limb is usually heavy and readily tired, there is non pitting œdema and the skin is thick ened and scaly If the deep veins are blocked, the varicose veins are compensatory and both operative and injection treatment should be avoided

Fig 421 —A convenient type of syringe for use in the injection treatment of varicose veins

Requirements —(1) A special varicose vein syringe (*Fig* 421), or a 2-c.c. or 5-c.c. Record syringe, (2) Several perfectly sharp needles—size 12 for large veins and size 16 for smaller ones, (3) Sterile swabs, (4) Spirit, or some other skin disinfectant, (5) Adhesive felt, cut the size and shape of a finger, (6) Flexible adhesive plaster and crepe bandages

Sclerosing Solutions —There are several solutions in common use, each has its advocates, and not infrequently it will be found that varicosities resistant to one solution sclerose with another

1 *Quinine Hydrochloride and Urethane* —A very effective solution, causing little pain on injection. The dose is 2–4 c.c., but, as idiosyncrasy is not infrequent, it is advisable to start with a small dose (½–1 c.c) Any leakage outside the vein is liable to produce necrosis and ulceration

2 *Lithocaine* —Dose 2–4 c.c. A painless and effective agent usually given simul taneously with quinine hydrochloride In handling the solutions the respective syringes and needles must be kept apart, for, if the two solutions make contact, precipitation occurs and blocks the needles

3 *Sodium Salicylate* —A 20–40 per cent solution is an excellent agent, especially for combined injection and ligature It causes little periveneitis, and can be used in doses of 5–20 c c *It has one disadvantage 30–60 seconds after injection the patient is* seized with a very severe cramp-like pain, extending downwards from the site of injection Apart from this temporary discomfort—lasting 2–3 minutes—there is no ill effect

4 *Sodium Morrhuate* is mentioned to condemn it It is not a stable chemical substance, and batches differ greatly in their efficiency and toxicity Urticarial manifestations are not infrequent, and some fatal reactions have been reported Like ethamoline, it is nearly painless if any escapes into the subcutaneous tissue

5 *Ethamoline, dose 1–5 c c, is related to sodium morrhuate, and has the advantage* of being a constant and true chemical compound It produces no general toxic effects and is a very good agent for simple injection When used for simultaneous injection and ligature, it is not as satisfactory as sodium salicylate, the clot is more bulky there is greater periveneitis, and the healing of the wound is often unsatisfactory

Technique of Injection —*It will generally* be best for the surgeon to sit down when making the injection, with the patient either standing on a stool or *seated on a chair* placed *on a low table*

Occasionally, a patient may faint during the injection, it is therefore advisable to have him held up by an assistant, or to provide some form of support for him to hold on to

Fig 422 —The needle has entered the vein and blood is being withdrawn into it

The surgeon sterilizes his hands and the skin over the proposed site of injection The vein is steadied by placing the left thumb and index finger on either side of it and the needle is introduced (*Fig* 422) *It is most important* to be sure that the needle is in the vein, and this is verified by aspirating a little blood into the syringe After the needle is in the vein, the left index finger is placed so as to compress the vein 1–1½ in above the needle, this empties the vein Then the left thumb is placed on the vein below the needle, a segment of vein is thus isolated between the two fingers The solution is injected slowly If a swelling appears, it means that there is a leak into the subcutaneous tissue, the injection must be stopped, the needle withdrawn, and a new attempt made Re-aspiration of blood in such cases does not necessarily mean that the needle is in the vein again, for the blood may be coming from a hæmatoma

When the solution has been injected the needle is held in position for thirty seconds After it is withdrawn, the leg is elevated and the puncture is lightly compressed with a wool swab for a minute

Firm compression of the varicosities will aid sclerosis and minimize the formation of large bulky clots Narrow strips of adhesive felt are placed along the line of the varicosities and fixed in place by strips of flexible adhesive plaster, which encircle about half of the circumference of the leg *If possible, it is well* almost to bury the pads by folding over from each side some skin—all being held in place by the adhesive plaster

The patient can walk home five to ten minutes after injection The treatment is entirely ambulatory, and need not interfere with the patient's daily routine

The order of injection makes little or no difference, but is is usual to start with the veins on the upper part of the calf, progressing downwards to the ankle and upward to the thigh. One large injection or two or three smaller ones may be given at one time, depending on the type of vein If a large comparatively straight vein is being dealt with, a single large dose is most advantageous, but for a group of minor varices on the calf a small injection may be made into the highest point of three or four branches

The intervals between treatments should be about one week, though, if there is any urgency, injections may be repeated every three to four days

Complications of Injection.—Provided that there is no contra-indication to injection, that care is taken that there is no leakage into the subcutaneous tissues, and that a suitable solution and dosage are used, there is little likelihood of any unpleasant results

Fainting—The possibility of the patient fainting during injection has been mentioned already He should be in a comfortable position and well supported, so as to safeguard him from a fall.

Periventitis and Phlebitis—If the dose has been too large, or injections started too soon after phlebitis, there may be an excessive reaction with periventitis A thick adhesive felt pad is placed on the vein just above the inflamed area, and smaller pads along the inflamed vein, and a flexible adhesive bandage is applied tightly from toes to above the adhesive pad The patient must be kept up and about and the bandage is kept on for from two to six weeks, provided it stays tight and in position The use of large doses of sodium citrate is often recommended, but it has no effect on the inflammation, and may even increase the clot.

Injection Ulcer—With the exception of sodium morrhuate and ethamoline, all of the solutions in common use are liable to cause necrosis and form an ulcer if any of them escape into the subcutaneous tissues There is immediate pain at the site of leakage and within a few days the overlying skin turns black and forms a slough The best treatment is to apply flexible adhesive plaster and leave it on until the ulcer heals—about two months

SIMULTANEOUS LIGATURE AND INJECTION

Every case in which the saphenous valves are incompetent should be treated by combined ligature and injection, provided none of the contra-indications to injection are present Injection alone in such cases is followed sooner or later by recurrence of the varicosities in not less than 50 per cent The need, and the levels, for ligature are determined by the Trendelenburg and tourniquet tests There are four possible sites for ligature (1) Internal saphenous vein at its junction with the femoral vein, (2) The mid thigh, (3) The lower thigh, and (4) External saphenous vein at its junction with the popliteal vein High ligature —at the saphenous opening—must be done in every case, the lower ligatures being complementary Ligature of the saphenous vein in the middle or lower thigh, unless combined with a ligature of the vein at its junction with the femoral vein, is followed by almost as high a rate of recurrence as simple injection.

Ligature of the Saphenous Vein in the Groin.—

Preparation—The patient is prepared and shaved as for an operation on an inguinal hernia. In male patients it will be found helpful to retract the penis and scrotum away from the site of the operation by a strip of adhesive plaster

Anæsthesia—Local infiltration with 1 per cent novocain is ideal for most cases

The Incision is 2 in long in the line of the groin, and centred on a line dropped vertically from the pubic spine

Ligature of the Vein—The vein is exposed by dissection (*Fig* 423) and divided between hæmostats Either before or after dividing the main saphenous vein, ligature and divide all its terminal tributaries—external pudendal, external circumflex iliac, superficial epigastric, and external superficial femoral veins The saphenous vein is then tied just below its junction with the femoral vein, and distal to this ligature it is again tied after transfixion

Injection, either of sodium salicylate 30 per cent (5–10 c c.) or ethamoline (4 c.c.), is made into the distal cut end of the saphenous vein *As it is difficult and unsatisfactory to make the injection with a needle, the following method is advised* A ureteric catheter is introduced into the cut end of the vein and gently worked down as far as it will go A syringe containing the sclerosing solution is connected to the catheter and the solution is injected as the catheter is slowly withdrawn from the vein Alternatively, Stevenson's 'needle (*Fig* 424), which is very effective, can be employed Having completed the introduction of sclerosing solution into the lumen of the vein, the distal cut end is transfixed *and doubly tied*

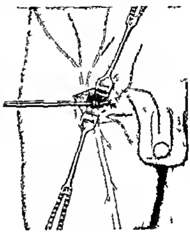


Fig 423 —Exposure of the termination of the saphenous vein

The wound is swabbed out with saline to remove any of the sclerosing fluid which may have leaked into it The incision is closed with two vertical mattress sutures of silkworm gut and is covered with gauze and Elastoplast A flexible adhesive bandage is applied from the toes to just below the knee

The patient should be encouraged not to lie up in bed, but to walk about from the start Any varicosities which remain can be dealt with effectively by injections when the bandage is removed—two to three weeks after the operation.

Fig 424 —Stevenson's needle

Apart from emphasizing the need for careful marking of the position of the vein before operation, there is no need to describe the technique of ligaturing and injecting the external saphenous vein or the internal saphenous vein in the middle or lower thigh

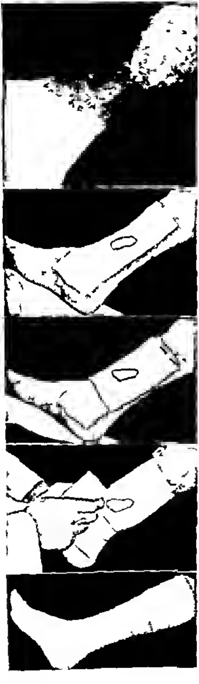
VARICOSE ULCERS

The modern treatment of varicose ulcers consists in the application of elastic compression to the leg from the toes to the knee, combined with the obliteration of the varicose veins Usually the veins can be dealt with at the same time as the ulcer

Before applying compression treatment, it is essential to exclude syphilis, diabetes, and severe *arterial disease of the leg* *If there is no pulsation to be felt* in the dorsalis pedis or posterior tibial arteries, compression is contra indicated, as it might precipitate gangrene in the leg

Flexible adhesive plaster bandages provide the most efficient method of applying the compression. In every case it is advisable to start with two strips of flexible adhesive plaster placed longitudinally one on each side of the leg from the sole up to the level of the upper calf. When there is much œdema or the ulcer is very large, additional strips up the front and back of the leg will help to prevent the spiral bandage cutting into the skin. The bandage is applied spirally from the toes upwards, enclosing the heel, to just below the knee, each succeeding turn overlapping two-thirds of the preceding one (*Fig.* 425, E). During the application of the bandage, the ankle-joint should be kept in a position of dorsiflexion to prevent rucking of the bandage when the patient walks.

Firm application is an *absolute* essential; the tightness of the bandage should be proportional to the degree of œdema and induration. The patient may complain that the bandage is too tight, but usually, after walking a short distance, all discomfort disappears.



A

B

C

D

E

Fig. 425.—Pressure bandaging an ulcer in the lower third of the leg. A, The ulcer. B, The longitudinal strip of Elastoplast has been applied; C, A rectangular piece of sticky felt with bevelled edges is now placed over the site of the ulcer. D, E, The leg from toes to knee is now bandaged tightly with adhesive plaster.

When œdema is very marked, the bandage rapidly loosens, and renewal may be necessary every three or four days, but in most cases it will not be necessary to change the bandage more often than every week or fortnight.

Preliminary cleansing of the ulcer is unnecessary, no matter how foul or how large the ulcer. The patient must be told that discharge from the ulcer may come through the bandage, and that if it does the bandage should be washed over with a wet sponge and then covered with a roller bandage. Itching under the bandage sometimes worries the patient, but usually this can be relieved by bathing with cold water.

In some patients, the use of adhesive plaster produces eczema or dermatitis Such cases can be treated with Viscopaste bandages or the application of Unna's paste (*see* p 279) over-bandaged with crepe or a flexible adhesive bandage

In dealing with large and deep ulcers with much surrounding œdema, it will be found helpful to put the patient to bed with the leg elevated for twenty-four hours When the œdema has been reduced by the rest, the ulcer is covered with longitudinal strips of flexible adhesive plaster, then a piece of sponge rubber is placed over the ulcer, overlapping it all round by several inches Finally, over all, a flexible adhesive bandage is applied as tightly as possible This method is especially useful in the treatment of ulcers in the region of the malleoli (*Fig* 426)

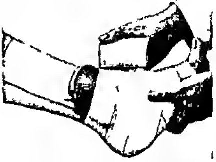


Fig 426 —Showing pad of Sorbo rubber being used in the bandaging of a varicose ulcer near the bony prominence of the internal malleolus

The compression treatment is essentially ambulatory The patient must be encouraged either to work or to take exercise to improve the circulation, and to keep up the pressure massage of the œdematous tissues between the adhesive bandage and the calf muscles When the ulcer has healed, it must continue to be supported for at least another three months with a Viscopaste or flexible adhesive bandage, and we must insist on seeing the patient then, and completing the treatment of any varicose veins that may remain

THE TREATMENT BY INJECTION OF BURSÆ AND GANGLIA

By Hamilton Bailey

Bursæ and ganglia respond to treatment by aspiration and injection in a manner comparable with that of varicose veins After using this method in a large number of cases, I have been astounded at the regularity with which these swellings are obliterated The solution I have used in all instances is quinine hydrochloride and urethane, and the dose is proportional to the size of the swelling —from 2 to 10 c c Usually two or three injections at weekly intervals are required, in a small number of cases four or five have been necessary

Ganglion.—A very wide-bore hollow needle is necessary After infiltrating the overlying skin with a few drops of novocain, the needle is plunged into the ganglion No attempt is made to aspirate the fluid, which is usually of the consistency of calves'-foot jelly The contents of the ganglion are squeezed through the needle and the sclerosing solution injected This is followed by a little massage in order to distribute the sclerosing solution The puncture is sealed and a firm bandage applied

Bursa —It is essential to be sure that the bursa does not communicate with a joint This, and the more obvious fact that injection treatment should not be undertaken while a bursa is inflamed, constitute the only contra-indications The fluid in the bursa is aspirated through a fairly wide-bore hollow needle, and a dose, usually of 5 c c of quinine hydrochloride and urethane, is injected A Sorbo rubber pad with firm pressure with a flexible adhesive plaster bandage, completes the treatment

CHAPTER LV

LUMBAR PUNCTURE AND ALLIED PROCEDURES

By HAMILTON BAILEY and C. ALLAN BIRCH

LUMBAR PUNCTURE

LUMBAR puncture should always be performed under the most rigid asepsis The hands of the operator must be prepared as for a surgical operation, the lumbar puncture needle boiled, and the skin of the patient prepared with iodine Spinal puncture should never be attempted through unhealthy skin or infected subcutaneous tissue

Lumbar Puncture Needles—Barker s needle is unnecessarily large for routine use, the smaller needle illustrated (*Fig* 427) will be found to be perfectly

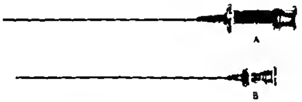


Fig 427—A Barker s needle B A smaller lumbar puncture needle for routine use

satisfactory for most cases It is, however, useful to have a Barker s needle for use in difficult cases, i e, where the patient is fat or osteo-arthritis prevents a full flexion of the spine

Position—This is the most important single factor in successful lumbar puncture *The vertical position* is used by some operators The patient is seated with his legs dangling and the back flexed strongly It is as well to have a nurse to stand in front of the patient to support him Obviously the position cannot be employed if the patient is unconscious or gravely ill It is for this reason that *the lateral position* has so much to recommend it—it is applicable to all cases In order to get the spine fully flexed an assistant places one arm under the knees and the other round the back of the neck (*Fig* 428), explaining to the patient the necessity to get the chin as near to the knees as possible The purpose of this flexion is to widen the intervertebral spaces and thereby facilitate the entry of the needle A roller towel placed round the neck and knees and tightened by twisting with a rod, sometimes helps to obtain and maintain the flexed position when other methods fail

As emphasized throughout this article, full flexion of the spine is a prime consideration running it closely is the prevention of sagging of the spine The long axis of the spine should be parallel to the floor If the puncture has to be made in bed it is wise to insert a flat board between the mattress and the springs Failing this, get the patient right on to the hard edge of the bed

No attempt should be made to proceed with the puncture unless the operator is satisfied with the position

Site of the Puncture.—The puncture can be made at any level, but the site of election for general purposes is between the 3rd and 4th or the 4th and 5th lumbar vertebræ The latter space lies on a line joining the uppermost points of the iliac crests

Fig 428 —An assistant places one arm under the knees and the other round the back of the neck in order to flex the spine as fully as possible

Sterilization of the Skin.—A wide area of the skin of the back is sterilized with iodine, and sterile towels are arranged about it

Defining the Intervertebral Space and Injecting Local Anæsthetic.—Using the left thumb, a space between two spinous processes is selected The spinous process below must be felt and the spinous process above Resting the pulp of the thumb on the spinous process above, the skin is stretched in an upward direction, the patient is warned that there will be a prick, and a little novocain is injected into the skin The needle is then inserted more deeply, and some more local anæsthetic injected

The Puncture.—The left thumb again determines the space, and, as before, the skin is stretched by moving the thumb upwards so that it rests on the inferior surface of the upper spinous process The lumbar puncture needle is grasped firmly by the hilt in the right hand, and its point is inserted through the skin of the interspace, guided by the left thumb nail (*Fig* 429) The needle is advanced a short way perpendicular to the skin surface At this juncture the left thumb is removed, and the needle advanced carefully by steady pressure with *both hands*, the left hand holding the shaft of the needle to prevent it going too far when the resistance of the deep tissues is overcome A slight 'give' will be felt when the ligamentum flavum is pierced Often a second sensation of 'give' is experienced when the dura has been punctured

The stylet is then removed and, in a successful puncture, the cerebrospinal fluid drips or pours from the hollow needle

Difficulties—If the cerebrospinal fluid fails to appear, the needle, without the stylet, is advanced very cautiously a few millimetres If this fails, the needle

is rotated and withdrawn a little When there is still no flow, the stylet is replaced and then withdrawn If cerebrospinal fluid still fails to appear on removing the stylet for the second time, the needle is again rotated, since it is possible that the point may be obstructed by a nerve-root or the arachnoid Should the patient complain of pain down the leg, the needle has struck one of the roots of the cauda equina lying outside the dura The point of the needle must then be withdrawn almost to the skin and reinserted, giving it a slight upward tilt

Bone is encountered When the point of the needle, instead of finding the interspace, impinges upon bone, it usually means that the flexion is insufficient The needle should be withdrawn and another attempt to get more satisfactory flexion of the spine must be tried This requires patience on the part of the patient, the assistant, and the operator, but it is time well spent

Fig 429 —Method of holding an infant for spinal puncture

Another attempt is made to insert the needle, this time altering the direction so as to give the needle a somewhat upward tilt It this is of no avail, instead of introducing the needle exactly in the middle line it is inserted about a quarter of an inch laterally If no success is achieved by these expedients, another interspace is selected, local anæsthetic injected, and the procedure begun anew, this time using a Barker's needle

Even an experienced operator will meet cases where osteo arthritis of the spine prevents proper flexion and consequently the dura cannot be entered Such cases should constitute not more than 1 per cent

Blood or blood-stained fluid 'Bloody taps' usually occur when difficulty is experienced in performing the puncture Often the needle has been introduced too far, and by withdrawing it slightly the blood-stained fluid becomes progressively less bloody In cases of head injury when blood-stained fluid is withdrawn, it is necessary to know whether the blood is due to trauma caused by the needle or if it is due to previous subarachnoid hæmorrhage The following table will be helpful in elucidating this important differential diagnosis (Merritt and Fremont Smith)

	'Bloody Tap'	*Previous Subarachnoid Hæmorrhage*
Pressure	Often low	Usually high
Amount of blood	Varies in different tubes	Admixed evenly
Clotting	May occur	Always absent
Centrifuging	Supernatant fluid colourless	Supernatant fluid xanthochromic

Post-operative Headache —In a small, but definite, group of cases headache occurs after lumbar puncture and spinal anæsthesia Although it is admitted that persistent headache is more frequent after spinal anæsthesia than after

simple lumbar puncture, it is the lumbar puncture, rather than the anæsthetic agent, which is the cause Possibly a few of these troublesome headaches, which are often occipital, or even located in the back of the neck, are due to a mild chemical meningitis, in which case a spinal anæsthetic is responsible In the majority of instances the headache is due, not to increased pressure, as was thought formerly, but to reduced pressure consequent upon cerebrospinal fluid leaking through the puncture hole in the dura into the epidural space If this theory is correct, measures to reduce intracranial pressure are misdirected, and would only aggravate the symptoms

Prevention —Headache can be prevented by performing the puncture with the patient in the recumbent position, and keeping him flat in bed for 48 hours (J E Moore)

Treatment —Time should not be wasted in administering usual remedies for headache, in this instance they are useless H Dodd advises that 20 c c of a 30 per cent (hypertonic) solution of saline should be injected slowly intravenously as soon as the patient complains of headache The earlier the injection is made, the sooner there is permanent relief of the symptoms The injection can be repeated in six hours, if required If Dodd s method is regularly successful, it is obvious that the older theory is correct

MEASURING THE CEREBROSPINAL FLUID PRESSURE

It is erroneous to suppose that the cerebrospinal fluid pressure can be estimated, even approximately, by observing the rate at which the fluid escapes through a lumbar-puncture needle, a spinal manometer must be employed Of several patterns, Guy's Hospital manometer (*Fig* 430) will be found satisfactory

A special lumbar puncture needle (*Fig* 430) is inserted and the stylet withdrawn until cerebrospinal fluid is seen welling up through the lateral opening The stylet is then reinserted to prevent the escape of fluid while the manometer tube is attached and held vertically As the stylet is withdrawn, fluid can be seen rising in the gauge

Normal pressures vary between 100 and 200 mm of fluid Often the pressure rises above the normal at first, but soon settles to a steady level, which is marked by the slide attached to the tube Pressures over 200 mm indicate increased intracranial pressure if they are not due to nervous embarrassment of respiration In Queckenstedt's test an assistant presses gently on the internal jugular vein Normally this causes a rapid rise of fluid in the manometer, but when the space between the cord and the dura is blocked or narrowed, there is no such rise or only a sluggish one

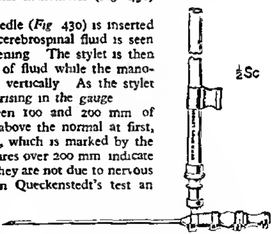


Fig 430 — Guy s spinal manometer

SPINAL ANÆSTHESIA

There are a large number of various anæsthetic agents, and the technique of their administration is so variable that it would be dangerous to detail any description of spinal anæsthesia in a work of this character The house-surgeon must receive practical instruction in the particular product which is employed in the hospital where he works

In a different category is low spinal anæsthesia, which is a perfectly safe method of anæsthetizing the anus, perineum, male urethra, and external female genitalia Stovaine, ½ c c in saline, is injected intrathecally between the 4th and 5th lumbar vertebræ The patient sits up for one and a half minutes There is no shock and no need for cardiac stimulants

CISTERNAL PUNCTURE

The most reliable technique is that of Castex and Ontaneda, which depends on the fact that a line joining the tips of the mastoid processes bisects the occipito-atlantoid space

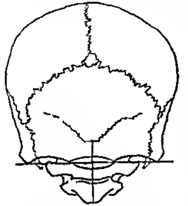


Fig 431 —The point of entry of the needle at the intersection of a line joining the tips of the mastoids and the vertical midline of the neck.

The neck is shaved and the external landmark made at the point where the horizontal curved line joining the tips of the mastoids cuts the vertical line of the neck (*Fig* 431) These lines are made by the use of a tape measure and grease pencil The patient lies

Fig 432 —Purves-Stewart's cisternal needle

with his head at the foot of the bed so that the bed-post is not in the way, and the head is supported on a small pillow so that the cervical spine is horizontal and flexed The skin is dabbed with iodine and the landmark is anæsthetized with novocain

A Purves-Stewart needle (*Fig* 432), graduated in centimetres, is introduced horizontally at the entry point and kept strictly in the midline (*Fig* 433) The blunt stylet is pressed home after each cautious advance until the occipito-atlantal ligament is felt The stylet is then withdrawn a little and the ligament penetrated A characteristic 'feel' may be experienced As soon as fluid appears the needle must not be moved farther lest the medulla be injured

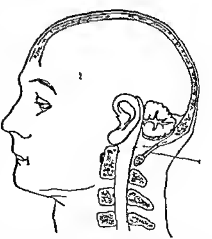


Fig 433—Showing the direction of the needle, which has reached the atlanto-occipital ligament.

A refinement is to determine before puncture the exact depth at which the cistern will be punctured This is done by measuring how far in a sagittal plane the entry point is behind the vertical plane through both mastoids This 'skin mastoid' distance is the shortest distance from the tip of one mastoid to a transverse line through the entry point It is measured by placing one limb of a folding ruler transversely over the entry point while the other limb at right angles to the first is placed antero-posteriorly under the lobule of the ear The distance from the mastoid to the transverse limb is read off An average reading is 7 cm By subtracting 2½ cm we have the depth of the occipito-atlantal ligament in any given patient But since the ligament and dura are about ½ cm thick, we subtract 2 cm to get the depth of the cistern. Roughly the cistern is reached 2 in from the skin and there is another ¼ in to go before the medulla is injured

CHAPTER LVI

GYNÆCOLOGICAL PROCEDURES

By Norman White

GYNÆCOLOGICAL EXAMINATION

It is difficult to make a thorough examination in cases of vaginal discharge without using the lithotomy position

Palpation —The *urethra* is swabbed clean and palpated through the anterior vaginal wall, pus may be expressed from it

Skene's tubules are sometimes infected, and pus can be expressed from their openings, which lie on the dorsal edge of the urinary meatus or just within the opening

An enlarged *Bartholin's gland* can be felt by pinching up the tissues at the side of the introitus with the finger and thumb, the normal gland is impalpable Mucus or pus may be expressed from the duct, the opening of which lies on each side just outside the hymen

A finger is now introduced into the vagina and the walls are palpated A lubricant should be used, unless the vaginal discharge is to be examined bacteriologically The *direction in* which the cervix points is noted, and the fornices palpated for any induration or swelling On bimanual examination the uterus should be felt between the hands, through the anterior fornix If the cervix points anteriorly the body is probably posterior, and an attempt should be made to antevert it for thorough palpation In the lateral fornices the normal ovaries can often be felt bimanually, but the normal Fallopian tubes are *impalpable*

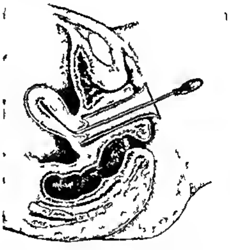


Fig 434 —Taking a cervical smear

Inspection —For inspection of the vagina and cervix a bivalve speculum is usually best It can be introduced easily, without touching the sensitive vestibule, and separation of the blades gives a good exposure of the cervix and fornices Fergusson's speculum sometimes gives a better exposure of the cervix To introduce either of the foregoing the labia are separated and the end of the speculum is slipped over the edge of the perineum When the vagina is narrow and a Fergusson's speculum is being used, it will enter more easily if it is given a rotary motion The Sims, or duckbill, speculum is useful to inspect the anterior vaginal wall, but does not give a good exposure of the cervix, and requires holding during the examination

The vaginal discharge is mopped away with a dry swab on a sponge forceps, and the appearance of the cervix is noted If a cervical smear is to be taken for bacteriological examination, it is very important that it should be *endocervical* (*Fig* 434), and not contaminated with vaginal discharge, which usually contains

Fig 435—Playfair's probe

many more organisms A Playfair's probe (*Fig* 435), which has a roughened surface designed to hold a small piece of wool or a platinum loop, is used for this purpose In cases where carcinoma is suspected, a probe or sound is useful to test the cervix for friability

DILATATION AND CURETTAGE

Preparation for the operation includes shaving and washing the vulva, but the pubes need not be shaved before minor operations, as this area can easily be covered by towels If there is an infective vaginal discharge, douches of dettol (0 5 per cent) or lysol (20 min in 1 pint) should be given for two or more days *before operation* *In many cases the douche may be omitted*, *always if the* patient is a virgin

When anæsthesia has been induced, the patient is put in the lithotomy position and the vulva and vagina are swabbed with an antiseptic, such as 30 per cent dettol or a 1–1000 solution of flavine in spirit A bimanual examination is done and the position of the uterus specially noted, this is a most important part of the operation If the vagina is small, a Sims speculum will be used to expose the cervix, in most cases the weighted Auvard's speculum (*Fig* 436) is not too large and gives better exposure The anterior lip of the cervix is seized with one or two vulsellum forceps, and pulled down. A uterine sound is passed into the cervical canal in the direction in which the uterus was found to lie on bimanual examination If the uterus is retroverted and the sound is passed with the point forwards, the wall may be perforated, a senile uterus, and a uterus which has recently been pregnant, are so soft that the wall offers little or no resistance to a sound pressed against it.

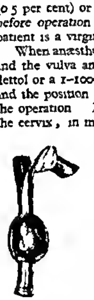


Fig 436.—Auvard's speculum

The uterine sound is bent at 2½ in from the tip, the length of the cavity of the normal virgin uterus, and the rest of the shaft is marked by grooves at 3½, 4½, and 5½ in, so that a longer cavity can be measured.

Metal dilators are now passed in successively larger sizes, each being held with the finger and thumb about 2½ in from the end, so that the point will not perforate the fundus if the dilator slips suddenly through the internal os The operator must be careful not to lacerate the cervix by dilating it too quickly, or by passing unnecessarily large dilators The next procedure is to pass a pair of forceps—narrow bladed sponge forceps are quite suitable—into the uterus, and open, close, and withdraw them, in order to remove any polypoid material This is very important in cases of incomplete abortion in which the curette may fail to separate adherent fragments

A curette (*Fig* 437) is passed gently to the fundus of the uterus, and the walls are scraped by drawing the curette down in contact with them A sharp

curette is used in gynæcological cases, but in pregnancy, and when abortion has *occurred recently, this instrument may easily perforate the uterus or remove* large pieces of the muscular wall In such cases the forefinger is the safest instrument to employ, if the cervix is large enough to admit it If introduced gently in the right direction, sponge-holding forceps are unlikely to do harm If the uterine wall feels moderately firm, a blunt curette may be preferred to the sharp one Fragments separated by the curette are removed by passing the forceps again after curettage Microscopical examination of the curettings should never be omitted in gynæcological cases, because apparently innocent fragments are sometimes shown to be carcinomatous by the microscope

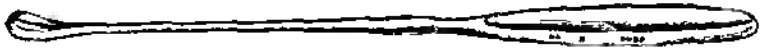


Fig 437 —Sims sharp curette It is made in three sizes— [illegible] in., [illegible] in and [illegible] in.

Complications of Curettage.—Excessive hæmorrhage is unusual, except when pregnancy or a placental polypus is being removed Sudden profuse bleeding can be controlled at once by compression of the body of the uterus between two or more fingers of the right hand in the vagina and the left hand pressing down the uterus per abdomen into the anteverted position A douche of sterile water at 120° F is very useful in stopping a less acute loss, and should always be available when *the operation is being performed in a case of recent* pregnancy A special uterine douche tube with a channel to allow escape of the fluid should always be used (*Fig* 438) A vaginal douche tube, or ordinary tubing, may block the cervix, and fluid may be forced through the Fallopian tubes into the peritoneal cavity One cubic centimetre of pituitrin or ergometrine may be given by injection, either intramuscularly or into the uterus itself If other means fail, the uterus and vagina may be plugged with a roll of sterile gauze

Fig 438 —Bozemann's intra-uterine douche.

Very little gauze can be introduced into the uterus after ordinary dilatation and curettage, but the vagina can be plugged, and this must be done thoroughly if it is to be of any use The plug should not remain in for more that twenty-four hours

The *dilators* or the *vulsellum forceps sometimes* lacerate the cervix, and a catgut suture may be required Infection is a rare complication, unless the organisms are already present in the uterus, as in some cases of abortion

LEUCORRHŒA

The commonest cause of vaginal discharge is excessive production of mucus by the cervix, which may show an erosion on the vaginal surface This may be due to *chronic cervicitis, but there is usually no active infection present* A mucoid, non-purulent discharge may be treated with glyco-gelatin pessaries, one introduced into the vaginal vault every night, and douches of a mild antiseptic such as dettol one drachm to the pint, or lysol 20 min to the pint Cauterization

of the cervix is a more effective measure, and may be done in the out patient department without an anæsthetic, a swab soaked in 2 per cent novocain can be pressed against the cervix for a minute or two if the patient is unusually sensitive If the mucus comes from the cervical canal, and not from an erosion, it may be necessary to give an anæsthetic and dilate the cervix. The cervical canal should be cauterized deeply in three lines from the internal os downwards (*Fig* 439) Cauterization should not be performed just before or during a period, for under these conditions the hæmorrhage would be unduly heavy The ulcer will probably take a month to heal, and douches should be given during this time If the cervical canal has been cauterized, the patient must attend for observation and, if necessary, dilatation of the external os, to prevent stenosis

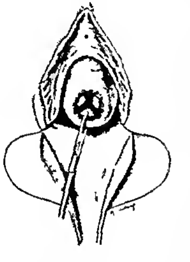


Fig 439 —Showing lines of cauterization of the cervix for leucorrhœa

Infective discharges may be due to gonorrhœa, *Trichomonas vaginalis*, *Monilia* (especially in diabetes), *Bacillus coli*, or other organisms The discharge is purulent or muco-purulent, and vulvitis and vaginitis are often present Trichomonas vaginitis may be treated with Stovarsol or Devegan tablets, one or two introduced into the vagina daily, and a douche to wash away the debris, or with Picragol pessaries, one daily It is important that the pessaries should be introduced up to the posterior fornix in order to treat the whole vagina, they should therefore be used after the patient lies down at night. If the infection is not controlled it may be necessary to have the pessaries introduced by a nurse, or Picragol powder may be blown in by an insufflator to cover the whole vaginal wall Treatment is needed for at least two or three weeks, and recurrence is common Other forms of vaginitis usually respond to 5 per cent lactic acid pessaries and a ½–1 per cent lactic acid douche Gentian violet 1 per cent is useful in monilia infections

Senile vaginitis should be treated by douches of normal saline, or of bicarbonate of soda, 1 drachm to 1 pint Antiseptics only injure the delicate vaginal epithelium An œstrogen such as stilbœstrol may be given to restore this epithelium to its preclimacteric condition It is advisable to start with a dose of 0·5 mg three times a day—reducing this to once daily or less frequently, or replacing it by œstrone 1000 international units daily, after the vaginal smear begins to show mature epithelial cells and many Doderlein's bacilli The œstrogen treatment should not be continued indefinitely, as it may cause hypertrophy of the endometrium and uterine hæmorrhage

Infection of Skene's tubules with gonococci or other organisms sometimes causes recurrent vaginitis and pain and frequency of micturition The tubules may be syringed out with 10 per cent mercurochrome, using a small syringe with a blunt needle such as is used for the nasolacrimal duct A better way is to destroy the tubule by an electric cautery or diathermy, under general anæsthesia, opening it up into the urethra

VULVAR ADHESIONS AND IMPERFORATE HYMEN

Vulvar Adhesions.—Congenital adhesions between the labia sometimes obstruct the vaginal opening Similar adhesions may follow vulvitis in childhood They can easily be broken down with the finger under light anæsthesia, and prevented from re forming by dressing with sterile vaseline afterwards

Imperforate Hymen—So-called imperforate hymen is usually due to a transverse septum just above the hymen, which is visible below it This condition is often not diagnosed till puberty, and the vagina, uterus, and tubes may be distended with menstrual fluid The operation required is simple excision of the septum, which can be seen bulging with dark-coloured blood The patient must be admitted to hospital, because strict asepsis is necessary during drainage *An ascending infection may cause salpingitis and peritonitis*

VULVAR PAPILLOMATA

These are commonly called gonorrhœal warts, but they occur in the absence of gonorrhœa, and are due to a filter-passing virus They are usually easily removed by touching once or twice with a wart paint, such as equal parts of liquor epispasticus and tinct ferri perchloridi, or with acid nitrate of mercury, or trichloracetic acid

VULVAR LACERATION AND HÆMATOMA

This type of injury requires careful examination under general anæsthesia If a rectovaginal fistula has been produced, the rectal and vaginal walls must be repaired separately from the vaginal aspect, each with a row of interrupted catgut sutures No 00 catgut should be used for the rectum, and No 2 for the vagina When proper access to the fistula cannot be obtained through the vagina, it may be necessary to divide the sphincter, and then suture the rectal wall from the upper end of the laceration

The bowels should be kept confined for six days after the operation Liquid paraffin is given daily after the second day and an aperient on the sixth

DILATATION OF THE VAGINA FOR DYSPAREUNIA

Under gas anæsthesia, the lower vagina should be dilated thoroughly with two or three fingers The patient should attend three times weekly after this for the passage of well-lubricated vaginal dilators, which are made in graduated sizes If the dyspareunia is due to spasm, it will probably be necessary to admit her to hospital for a small plastic operation to enlarge the introitus and divide the constricting muscle fibres After this, vaginal dilators should be passed regularly

TREATMENT OF ABORTION

When hæmorrhage occurs from the uterus in early pregnancy, it is first necessary to decide whether the condition shall be treated as threatened or as inevitable abortion In threatened abortion there is hope that the bleeding may cease and the pregnancy continue The treatment is complete rest in bed, an injection of morphine gr ¼, and a sedative mixture containing bromides and tincture of opium The diet should be light, and the bowels may be opened, if necessary, by a small enema, purgatives should be avoided at first Progesterone, the corpus luteum hormone, may be given intramuscularly in doses of 2–5 mg daily It is probably more useful if given for a week or more at the time when a period would have been

expected, i e , when abortion is most likely to occur, and before hæmorrhage has actually started

When the uterus is making definite expulsive contractions or when the cervix is partly dilated, abortion is inevitable Expulsion should be assisted by giving pituitary extract in doses of 5 units, repeated once or twice if necessary at two hourly intervals The injection should not be repeated if the uterus is contracting well and bleeding is not excessive If hæmorrhage continues in spite of these injections, dilatation of the cervix and removal of the ovum with a finger and sponge forceps should be done An alternative treatment is plugging the cervix and vagina firmly under anæsthesia If it is possible to empty the uterus, plugging should be avoided, as it invites sepsis Ergot and its derivatives may cause dangerously strong contraction, and must not be given before the delivery of the ovum if the pregnancy is of more than four months' duration

Septic Abortion—In septic abortion, operation may spread the sepsis The patient is treated by sulphanilamide, 2 g , followed by 1 g four-hourly for a few days Pituitary extract and ergot are given as mentioned above

If the whole placenta or a large part of it is retained, drainage will be obstructed, and dilatation of the cervix, with gentle exploration of the uterine cavity by the finger or sponge forceps to remove the placenta, is advisable Drainage from the uterus may be promoted by the introduction of a catheter through the cervix and the injection of ½–1 oz of sterile glycerin, if exploration under anæsthesia is not thought advisable In many cases the organisms are of low virulence and are able to cause infection only because placental remains and poor drainage provide a good culture medium A culture should be taken from the cervix to determine what organisms are present Gentle exploration is not likely to do harm unless hæmolytic streptococci are found, when previous treatment with sulphanilamide by the mouth is advisable Douches should never be used for the treatment of sepsis Curettage of the uterus is a dangerous operation in the presence of sepsis

PESSARY TREATMENT OF PROLAPSE

The symptoms of uterine and vaginal prolapse are sometimes relieved by the insertion of a ring pessary into the vagina, but the condition can be cured only by operation The most useful type of pessary is the ring type, made of watch-spring covered by indiarubber It is introduced into the vagina by squeezing it into an oval shape with the finger and thumb, pushing it through the introitus, and guiding the upper end past the cervix into the posterior fornix A suitable pessary should cause no discomfort When the introitus is narrow, a piece of tape is wound round the pessary and fixed with a pair of Spencer Wells forceps, to keep it compressed (*Fig* 440) until the upper end reaches the posterior fornix, when the release of the forceps and removal of the tape allow the pessary to take its correct position, with the cervix in the centre

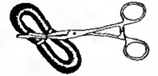


Fig 440—Watch spring pessary ready for insertion in a case where the introitus is narrow

A rubber pessary perishes quickly, and must be replaced by a new one every three months It is removed by traction with the fore-finger, and rotation into the antero posterior diameter as it comes to the outlet A vulcanite ring pessary is useful when the outlet is so large, or the perineum so lax, that a watch spring

pessary cannot be retained It may last longer than the three months, but should be removed and inspected at this interval It is necessary for a patient wearing a pessary to douche daily with saline solution or some very mild antiseptic, in order to prevent the vaginitis and leucorrhœa which the foreign body is liable to cause

PESSARY TREATMENT OF RETROVERSION OF THE UTERUS

Congenital retroversion, and retroversion caused by pelvic inflammation, are usually suitable only for operative treatment

Puerperal Retroversion.—*Puerperal retroversion* of the uterus may be treated by replacement with a pessary The type of pessary generally employed is the Hodge, the upper end of which is rounded to fit the posterior fornix, and the lower end square to rest against the lower vaginal wall and the lower part of the symphysis, *it is S-shaped, and when it is in place, the upper end projects forwards*, above and behind the cervix A ring pessary will also maintain the uterus in anteversion, and is useful when the introitus is too lax to retain a Hodge pessary

Introduction of the Pessary—The uterus must first be replaced into the anteverted position by digital manipulation With the patient in the left lateral or semi-prone position, two fingers of the right hand are introduced into the vagina, and the body of the uterus is pushed up in the posterior fornix as far as possible with the middle finger, the forefinger then presses the cervix backwards, and so levers the body forwards till it can be pushed down by the left hand per abdomen The fingers are now withdrawn and the pessary is taken in the right hand, the left forefinger retracts the perineum and assists its introduction through the introitus, and the right forefinger then guides the upper end of the pessary into the posterior fornix above the cervix If the pessary is of suitable size, the patient should not be conscious of anything in the vagina

Treatment by a pessary, after replacement, will usually effect a permanent cure of puerperal retroversion, if it is begun at about five weeks after delivery, the pessary should be retained for three months When the condition has not been diagnosed till later, the uterus can generally be anteverted, but removal of the pessary may allow the retroversion to recur It may be necessary for the patient either to continue wearing the pessary, which is removed and inspected every three months, or to have an operation In difficult cases replacement may be performed under anæsthesia, with a sound or dilator in the uterus, it is of course quite useless to introduce a pessary without first manipulating the uterus into anteversion

Retroverted Gravid Uterus.—This condition causes trouble at about ten to twelve weeks' gestation No treatment is needed till the uterus is of ten weeks' size, when it may be found to be undergoing spontaneous anteversion, which occurs in the majority of untreated cases The anteversion may be assisted by pushing up the fundus with one or two fingers in the posterior fornix, and a pessary may be introduced if the retroversion seems likely to recur It is safer to keep the patient in bed and attempt replacement by postural means rather than manipulation, especially if the retroversion has been responsible for a previous abortion

Another method of securing anteversion in cases of retroverted gravid uterus is to introduce a ring pessary, the continuous pressure of which will gradually press the uterus upwards into place

If the condition has not been treated early in pregnancy, retention of urine may occur when the uterus is large enough to fill the pelvis and force the bladder

above the pubes The treatment for this is catheterization, the urine being removed at the rate of about a pint an hour, in order to avoid the danger of hæmorrhage, which may occur if the pressure in the bladder is released too suddenly When the bladder is kept empty by a catheter, spontaneous anteversion of the uterus generally follows, and may be assisted by keeping the patient in the prone position If necessary, the fundus uteri can be pushed up with the fingers in the posterior fornix, while the patient is in the knee chest position

PALLIATIVE TREATMENT OF ACUTE SALPINGITIS

Acute salpingitis is treated by the Ochsner Sherren régime (*see* p 194) Sulphapyridine is given in doses of ½–1 g three times a day Heat may be applied to the pelvis by means of short-wave diathermy, if this is not available, radiant heat may be given to the lower abdomen for ten to twenty minutes twice a day To decrease the inflammation from the vaginal aspect glycerin tampons, pledgets of wool soaked in glycerin with a tape attached to make removal easy, are introduced into the posterior fornix once or twice a day, glyco-gelatin pessaries may be used in the same way A hot douche of 5 per cent saline, or with some mild antiseptic, is given twice daily

Fig 441 —Posterior colpotomy

The patient must be kept in bed until the tubal inflammation has subsided completely If the pelvic inflammatory masses increase in size instead of decreasing, operation may be necessary An abscess palpable as a soft fluctuating swelling in the posterior fornix may be opened by posterior colpotomy

Posterior Colpotomy—This is performed by introducing a vaginal speculum, pulling the cervix forwards with a vulsellum forceps, incising the vaginal wall just behind it with a knife (*Fig* 441), and pushing a pair of sinus forceps into the abscess A flanged tube is inserted for a few days to secure drainage If the pelvic mass is lateral, and not close to the posterior fornix, it is better to drain it per abdomen

CHAPTER LVII

OPERATIONS UPON THE TONSILS, HARE-LIP, AND CLEFT PALATE

By Denis Browne

REMOVAL OF TONSILS

Anæsthetic —Intratracheal gas and oxygen for choice The safety of the airway given by this more than compensates for the slight obstruction of the tube Otherwise ether vapour given through a weighted hooked airway hung in the mouth

Position —On the back, on a horizontal table, with a sandbag under the shoulders, raising them till the face lies naturally at an angle of 45° to the vertical This allows blood or fragments of tissue to drop into the nasopharynx rather than into the glottis

Gag —A Waugh's gag (*Fig* 442) combined with a sharp tongue forceps has the advantage that the tonsillar fossa is opened widely and pulled forward rather than stretched and narrowed at the back of the throat as by the Davis gag The latter, however, when once adjusted does not need an intelligent assistant to hold it, as does the tongue forceps

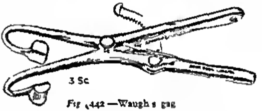


Fig 442 —Waugh's gag

Anatomy —The descriptions of the tonsil in anatomical text-books are notoriously contradictory and inaccurate The main points of importance in tonsillectomy are —

1 The upper half of the capsule of the tonsil is divided by a loose areolar space from the palate muscles In this space the dissection should begin, and it is in it that a quinsy forms

2 The lower half of the capsule has the palate muscles inserted into it, so that they lift it up and back over the descending bolus during swallowing

3 In addition to the muscular suspension there is a fibrous one, as in the case of the testis The suspensory ligament runs from the sheath of the tongue muscles to the angle of the tonsil that lies between the tongue and the anterior pillar (*Fig* 443) The early identification and cutting of this ligament is essential for a neat and rapid dissection.

4 There is one artery of supply—that from the facial, which enters the lower pole close to the tongue Like all arteries of this size, it ceases bleeding rapidly after division owing to the contraction of its walls, unless it is atheromatous

5 There is a vein unaccompanied by an artery, running in this areolar space, the paratonsillar vein (*Fig* 444), which is the almost invariable source of dangerous bleeding Like most unpaired veins, it varies greatly in size and may be double or treble When it is divided the bleeding end retracts into the upper corner of the tonsillar fossa, and has to be ligatured there

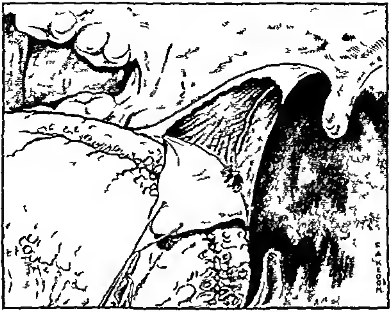


Fig 443 —Showing artery veins, and nerves en ering the hilum of the tonsil. The paratons llar vein s seen lying f ee on the muscular bed. The suspensory ligament running from the an erior angle of the on il in o the tongue is also shown.

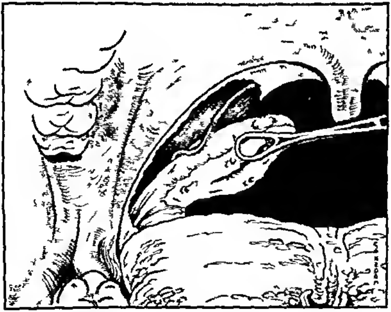


Fig 444 —The para onsillar vein adheres to the tonsil as t is dragged from ts bed The suspensory ligament s seen as appears in tonsillectomy

Instruments.—

1 Tonsil-holding forceps, with blunt overlapping jaws (Browne's, *Fig* 445) The only part of the tonsil which will allow the strong grip needed for dissection is the capsule, and this will stand far more tension when held by a blunt grip of this sort than when perforated by a vulsellum

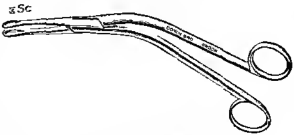


Fig 445 —Browne s tonsil holding forceps

2 Waugh's dissecting forceps, or the author's 'needle-catching forceps' (*Fig* 446) The latter has the advantage that the points can be inserted closed and then expanded always the best way of finding an areolar plane of cleavage

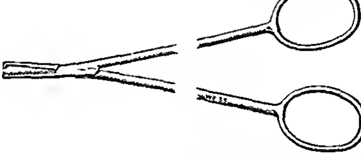


Fig 446—Browne s needle catching forceps

3 Ligature-carrying forceps (*Fig* 447) The author's pattern is bent so that the hand does not obstruct the view

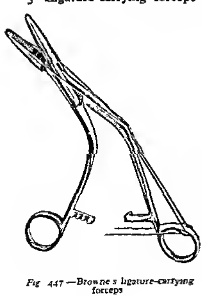


Fig 447—*Browne s ligature-carrying forceps*

4 Dissecting scissors

5 Suction aspirator, if possible

6 A liberal supply of gauze swabs, of size suitable to the patient

Method of Operating—Stand on one side of the patient, as this allows a far better view of the important upper part of the fossa than when at the head of the table Insert one blade of the holding forceps into the slit in the surface of the tonsil, called by anatomists the supra tonsillar fossa, and close them so that the other blade grasps the extreme edge of the mucosa of the anterior pillar Put this on the stretch by lifting the tonsil inwards and forwards, and with the sharp-toothed end of the forceps make a clean tear extending from the middle of the tongue border of the tonsil, along the anterior pillar, round

the upper pole, and as far as possible down the posterior pillar One of the commonest causes of difficulty is too small a first incision

Still holding the tonsil so that it bulges through the anterior pillar, deepen the incision till the white capsule shows Then shift the grip of the holding forceps on to this, and thrust in a swab that is about the size of the tonsil when tightly compressed This will define the suspensory ligament running from the angle between the anterior pillar and the tongue, and this should now be divided by light snicks with the forceps The tonsil can now be swung right out into the middle of the throat, and the posterior pillar pushed off it by gauze dissection which is continued firmly downwards to strip off the muscle attached to the lower part of the capsule

This finally should leave only a narrow pedicle containing the artery, which can be caught close against the tongue by the holding forceps and twisted off by a half turn of the wrist

A swab is held firmly in the fossa with one forceps, and the throat kept clear of blood with the other till the bleeding diminishes, as it will rapidly do Then any bleeding points should be treated precisely as they would be in an ordinary surgical operation and ligated immediately It is no more justifiable to try to stop venous bleeding by pressure, by stitching in swabs, and so forth, in this operation than it would be in a dissection on the outer side of the neck The artery to the tonsil, or the tiny branches to the mucosa along the tongue border, almost invariably cease bleeding rapidly and completely The reason why almost all writers on the subject believe the dangerous bleeding to be arterial is that venous bleeding in the neck usually comes in pulsating jets, though without the true arterial pressure

If bleeding should occur soon after the operation, it is best for all concerned to re-anæsthetize the patient and ligature the vessel The mental and physical suffering caused by attempts to stop it by pressure in a conscious patient are quite unjustifiable

A blood transfusion should be given if there has been much bleeding in such a case, not only as a life saving measure, but because of its great help towards convalescence

After-treatment —The patients should be encouraged to take as much glucose sweetened drinks as possible, and allowed to eat what they feel inclined to Ice cream is very useful with the young Never in any circumstances should a child be sent out of hospital within twenty four hours of the operation, and at least three days in bed is desirable

PERITONSILLAR ABSCESS

syn *Quinsy*)

This means a suppuration in the areolar space round the upper half of the tonsil, analogous to perirenal abscess or orbital suppuration It is due to infection in a tonsillar crypt spreading through the capsule If in a case of tonsillitis a swelling of the palate above the tonsil proper, and increase of pain on one side, show that a quinsy threatens, it may be aborted by sulphanilamide treatment In any case no operation should be attempted till fluctuation is present

Operation —This can be done in a tolerant patient without a general anæsthetic by incising over the middle of the fluctuant swelling (*Fig* 448) either with a tiny (No 15) Bard Parker blade, or with an ordinary scalpel with all except the tip of the blade guarded with sticking plaster A cocaine spray beforehand will

ıce the paın of ıncısıon, local ınjectıons, as ın all septıc condıtıons, are not :essful Through the ıncısıon sınus the 'needle catchıng' forceps should ınserted, dırectly backwards, and opened to allow pus to flow This ıs, at best, a paınful procedure, and ıt ıs ferable to gıve a general anæsthetıc An rator to remove the pus as ıt appears avoıd any danger of ınhalıng ıt

Severe bleedıng may occur at the tıme)peratıon or later, from the paratonsıllar ı Packıng the abscess wıth rıbbon ze may control ıt, but ıf ıt does not ıt ecessary to remove the tonsıl and lıgate bleedıng poınt

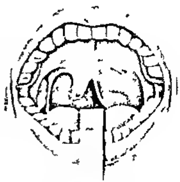


Fıg 448 —Perıtonsıllar abscess sıte of ıncısıon

RETROPHARYNGEAL ABSCESS

Thıs ıs a suppuratıon startıng ın the vertebral lymphatıc glands, analogous to acute streptococcal abscess of the neck ın seen ın chıldren It should be sus- ted when a chıld complaıns of dıffıculty swallowıng or breathıng comıng on faırly rapıdly ın the course of a throat ectıon, and can be best dıagnosed by palpatıon wıth the fınger Thıs fınds ıuctuant swellıng on one sıde or the other of the posterıor pharyngeal wall just ınd the tonsıl It must be dıstınguıshed from tuberculous ınfectıon of the ıe glands, and also from congenıtal aneurysm of the ınternal carotıd artery

Operation —Only ın the most urgent obstructıon should thıs be attempted :hout an anæsthetıc, though thıs should not be deep The control of the aırway en by a gag and tongue forceps may suddenly become very necessary ındeed

The head should be hung well over the edge of the table, as one of the maın ıgers ıs that of ınhalıng the suddenly released pus ıf thıs ıs allowed near the ynx The best method of openıng the abscess ıs by thrustıng a needle- chıng' forceps ınto ıt wıth one hand, whıle the other uses a suctıon aspırator clear away the pus ımmedıately ıt appears If thıs ıs deftly done not a drop let free ın the pharynx

Alternatıvely a guarded knıfe followed by sınus forceps may be used, and the s cleared away wıth swabs

HARE-LIP

The obstacles to the successful joınıng of a cleft of the lıp are three —

1. **Tension** —Thıs ıs of two kınds Fırst, the passıve tensıon due to the aggıng ınwards of the sıdes of what may have been a very wıde gap, and condly, the actıve tensıon caused by the contractıon of the facıal muscles ın yıng or feedıng The counter to thıs ıs the use of the 'tensıon brıdge' or odıfıed Logan's bow (*Fig* 449) Thıs has the advantage over the orıgınal odel that ıt can be tıghtened up to any desıred degree whıle ıt ıs ın posıtıon *'ıg* 450) It has two ımportant functıons apart from makıng unıon almost rtaın The fırst ıs that ıt greatly dımınıshes stıtch scarrıng, as ıt removes that ·ag whıch causes stıtches to cut through the tıssues ıf they are left unsupported :condly, ıt fulfıls the orthopædıc prıncıple of leavıng a joıned muscle ın the posı ɔn of contractıon durıng healıng A hare-lıp result ıs not good unless the

patient afterwards has the power of 'pouting' the lips, to ensure this the lips must be left in the 'pouting' position during healing by tight pulling of the sticking-plaster bands

2. **Irritation and Infection by Nasal Mucus**—In many cases after operation, there is a profuse discharge from the nostril If this is allowed to flow over the wound it has a very bad effect on healing The counter to it is to keep a loosely rolled

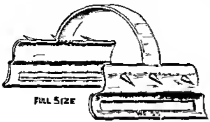


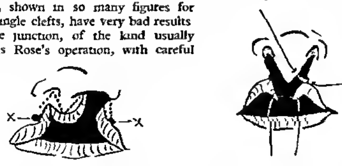
Fig 449—The tension bridge or modified Logan's bow

Fig 450—The 'tension bridge' in use

pledget of cotton-wool in the nostril, changing it as soon as it becomes soaked with discharge When the discharge is profuse this may mean many changes during the day It must be clearly understood that the cotton wool is not used as a plug, but should lie loosely in the nostril and soak up the discharge by capillary action

3 **Infection by Skin Staphylococci and Other Organisms**—This can be guarded against by keeping the wound lightly smeared with $\frac{1}{1000}$ flavine in paraffin In addition to its antiseptic action, this helps to protect the wound against any chance contact with nasal discharge

Formula for Joining the Lip—It is impossible to discuss this fully here It is, however, generally recognized now that the complicated flaps and zig zag incisions, shown in so many figures for joining single clefts, have very bad results A simple junction, of the kind usually known as Rose's operation, with careful



A B

Figs 451 A, B—Formula for joining a double-cleft lip At the points marked X a hole is punched on the mucocutaneous line with a 2 mm ophthalmic trephine. The cuts are made with a razor-edged chisel and the trephine hole is stitched to the centre of the side of the middle portion.

joining of the muscles, gives the best result For the much more difficult problem of joining a double cleft, the formula shown in *Fig* 451, A, B has been found in

practice to work exceedingly well It gives a thick, short, mobile lip with that double curve of the mucocutaneous junction known as a Cupid's bow, and avoids the undue length and tightness which gives that ape-like appearance so familiar after most of these operations

Finally, it may be pointed out that most accounts of the operation give no instruction to join the cleft of the floor of the nostril If the gap extends through this it should be treated precisely as is the gap in the lip itself, by making a raw surface on either side and suturing the two together

CLEFT PALATE

It should be understood that the object of operation on a case of cleft palate is not to close a gap, but to produce a function This function is that of the voluntary closing of the nasopharynx, without which correct speech is impossible Without discussing the vast numbers of procedures that have been recommended, it may be pointed out that success, as defined, turns upon giving a certain action to certain muscles, and that all these recommended procedures contravene the fundamental orthopædic principle that when a muscle is joined it should be left in the position of contraction during healing In other words, if it is required that the nasopharynx should have the power of closing after operation, it should be left in the closed position while the muscles join

To obtain this end two things are necessary First, a drastic and extensive freeing of the sides of the cleft, which will allow it to be joined close up against the posterior wall of the pharynx The incisions for this extend on either side from the canine teeth backwards along the pterygo mandibular raphe and through the empty tonsillar fossa left by a previous tonsillectomy The second is a device *which acts exactly as does the 'tension bridge' in treating a cleft of the lip* It is a thick catgut suture passed round the back of the pharynx and through the sutured soft palate tied so tightly as to occlude the nasopharynx temporarily Apart from fulfilling the orthopædic principle already mentioned, this device takes all tension off the suture line of the cleft and ensures complete healing in some 98 per cent of cases

The after-treatment of a cleft palate case should be much the same as that of a tonsillectomy The patient should be encouraged to drink as much as possible and allowed to eat any soft foods that are fancied Any attempt to syringe or clean the mouth will do more harm than good The severe pain so often seen after operation is mainly due to tension on the stitches, with the wide freeing recommended there is usually surprisingly little discomfort

Speech training is unnecessary if the child is intelligent, and is given a palate that will close the nasopharynx before it has acquired bad habits of speech In less successful cases it can do a considerable amount of good

CHAPTER LVIII

THE NOSE

By Eric Watson Williams

General Methods of Examination of the Nose, Throat, and Ear—Ordinary clinical examination comes first note swelling, tenderness, condition of glands, nervous system (paralyses, nystagmus), etc. Special methods demand illumination of the passages and cavities The light should not be too bright the best is a 60-c.p frosted electric bulb 6 in. behind and to the left of the patient's left ear (for examining the nose and throat), but any available source, even daylight, can be used. The forehead mirror should have a half inch aperture, not a peep sight Looking straight at the part move the lamp till it shines on the mirror, and the mirror till it illuminates the part. For bedside or operative work a forehead lamp with focusing lens is useful it should be small, and worn just above the inner canthus—one cannot examine the depths of a narrow cavity unless line of sight and beam of light are nearly coincident.

In using mirrors in the throat, proceed always in this way (*a*) Warm the mirror over a spirit lamp or in hot water, (*b*) Polish the surface, (*c*) Test the temperature on the back of your own hand (*d*) and on patient's cheek, (*e*) Pass the mirror without touching the tongue or tonsils If the fauces are very sensitive, spray with a few drops of 8 per cent rutocaine solution, or, *for adults only*, 5 per cent cocaine, being careful that *none is swallowed*, wait at least five minutes to allow the solution to be absorbed

EXAMINATION OF THE NOSE

Tilt up the tip and examine the vestibule for cartilage spurs, cracks, ulcers, etc otherwise these may be covered by the speculum and overlooked.

Fig 452—Thudichum's nasal speculum.

Fig 453—The use of the speculum.

Anterior Rhinoscopy—Thudichum's specula are the simplest choose one too small rather than too large, and hold it as shown (*Figs* 452, 453) Note (*a*) Mesially, the septum, observing any spur, bend, hollow, ulcer, or perforation, (*b*) Laterally, the head of the inferior turbinal, generally pink in colour, (*c*) Above and behind this the head of the middle turbinal, (*d*) The space between septum and turbinals, which is normally free from secretion

Spray the nose with the same precautions as detailed above and examine after five minutes The mucosa will be paler and the inferior turbinals should have shrunk so that almost the whole interior can be examined Wipe away any discharge (note whether offensive) With the head upright, discharge that re-appears over the head of the inferior turbinal must come from frontal or anterior ethmoidal cells, antral discharge appears much farther back over the middle of the inferior turbinal Absence of discharge does not exclude sinus disease

Examination of the Nasopharynx: Posterior Rhinoscopy.—Some practice is requisite to acquire the necessary knack for this procedure, but it is amply repaid

Ask the patient to breathe through the nose Using a tongue depressor in the left hand, pass the mirror behind the soft palate, keeping well below it do not touch the uvula—it is impossible to see the nasopharynx if the patient begins to gag First identify the sharp, white, vertical edge of the vomer (*Fig* 454) By turning the mirror slightly, bring into view the pale posterior end of the inferior turbinal of each side, with that of the middle turbinal above it the Eustachian orifice is seen laterally, and above the vomer is the vault of the nasopharynx

Fig 454 —Posterior rhinoscopy—diagrammatic

Note the situation of any discharge seen Frontal, anterior ethmoidal, and antral discharge appears between inferior and middle turbinals, posterior ethmoidal and sphenoidal discharge above the middle turbinal, on the back wall, or running down the vomer If adenoid hypertrophy is present, the characteristic vertical ridges hide more or less of the vault or even the upper part of the vomer In babies the simplest method of examining for adenoids is to palpate gently with the finger-tip

Transillumination of the Antra.—This has a limited value, though a negative result is inconclusive Darken the room completely and wait till the eyes are 'adapted', have dentures removed Pass the small electric lamp into the mouth so that it lies near the back of the hard palate, and tell the patient to close the lips *Fig* 455 shows on the patient's left side the normal appearance not only are the cheeks lit up, but also the infra orbital region, pupil, and front of the nose The right side shows the appearance when the antrum is opaque

Fig 455 —Suppuration of the right antrum of Highmore

X-ray Examination—A radiographic examination should always be made when there is any doubt as to the condition of the sinuses

NASAL OBSTRUCTION

Adenoids (*see* p 415)—The commonest cause in children

Septal Deviations.—Spurs, ridges and curves, seldom confined to the cartilage compensatory changes in the form of the turbinals are usual There is little relationship between the amount of deviation and the severity of symptoms treatment is operative Septal swelling may be due to hæmatoma (usually becomes absorbed), to empyema, which needs prompt evacuation to minimize deformity, or to gumma

Hypertrophic Rhinitis.—The mucosa is pale, swollen, and bathed in watery mucus Treatment consists in a deep longitudinal cauterization of the *head* of the inferior turbinal, or, in a bad case, removal of the hypertrophied *soft* tissues there with scissors do not remove the whole turbinal, treat the cause

Polypi.—These are usually multiple and indicative of ethmoidal disease They tend to recur rapidly unless the underlying disease is eradicated A

polypus which bleeds spontaneously or on gentle probing is to be regarded as malignant

Removal of Polypi —A polypus forceps with thin, serrated blades is the simplest instrument to use If a snare is employed, malleable silver wire, not too thin, is much easier to manage than springy steel wire, be sure that the wire has gone right over the polypus before tightening it Spray the nose with 5 per cent cocaine solution containing 1–10,000 adrenaline, and pack a strip of ribbon gauze moist with this solution high up in the middle meatus on each side of the neck of the polypus for ten minutes Seize the polypus by the narrow neck at the top of the hiatus semilunaris, well beneath (i e, out side) the middle turbinal (be careful not to catch the latter by mistake), and remove it try to pull away the attachment rather than to cut through the neck

THE TREATMENT OF EPISTAXIS

Usually the bleeding comes from the anterior part of the septum, and can be controlled by firmly compressing the nose between finger and thumb applied as far back as possible The pressure needs to be maintained from five to fifteen minutes a strong spring clothes peg well padded may be useful

Packing the Nose —This is indicated when the above measures prove inadequate Really good illumination is essential Have ready four yards of 1-in ribbon gauze, and 4 drachms (15 c c) of anaesthetic solution (*see* p 412) Spray the nose gently with a small quantity of the solution, taking care that none is swallowed Take a long narrow roll of wool of a size that will easily enter the nostril, moisten it with solution, wring it nearly dry, and pass it well back into the nose under direct vision, using a speculum to dilate the nostril It may be difficult to see much if the bleeding is free Unless you are sure bleeding is coming only from one side, repeat the process in the other nostril At the end of ten minutes, remove the wool You will find that the turbinals have shrunk very touch, so that the whole of the nasal chamber is easily inspected the mucosa is very pale, and perhaps a series of small purple veins is visible in the septum (note if there is any ulceration there) if all bleeding has ceased, do not be misled —it will probably recur with added violence

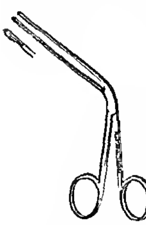


Fig 456 —Pritchard s forceps for packing the nose

Now that you can really see what you are doing, take half the ribbon gauze and proceed to pack the nose the gauze is seized with the forceps (*Fig* 456) about 5 in from the end, and carried straight up and back to the front of the sphenoid, leaving a short end outside the nostril—control this with one leg of the speculum so that it does not get pushed in Now pack the gauze in firmly, taking about 2 in each time and pressing each fold well back against the sphenoid, when about four or five such lengths have gone into place, a slightly larger loop may be used *Styptics* are seldom necessary 50 per cent glucose or viper venom solution (' Stypven ') may be employed

After-care —The packing should be removed next day or at the latest in two days, by which time it will have become foul If it is to be replaced, soak the gauze in bismuth oxycarbonate worked up into a thin cream with glycerin, an efficient antiseptic which does no harm if some is swallowed Prolonged packing leads to great risk of infection of sinuses and the middle ear

Cauterization —This is indicated instead of packing if conspicuous septal veins appear to be the source of the bleeding, especially if this recurs Great care should be taken to apply the cautery exactly where it is needed, usually near the floor of the nose The object is to obliterate the veins without damaging an extensive area of mucosa The nose is anæsthetized as already described a very thin wisp of wool is fixed firmly on a wool carrier, dipped in 20 per cent solution of silver nitrate (remove all excess), and held firmly against the spot selected for two minutes Alternatively, an electric cautery point may be employed see that it is 'cherry red'—if too hot it cuts rather than coagulates In either case remember that it is easier to repeat the application if too little has been done than to remedy extensive ulceration from doing too much A bland ointment should be used for a week after cauterization

REMOVAL OF ADENOIDS

The anæsthetic and position of patient are as for tonsillectomy (*see* p 405), with which operation this is often combined, do not over-extend the head, or the body of the atlas will project into the nasopharynx and hamper the operator Sir StClair Thomson's caged curette (*Fig* 457) is the most convenient instrument,

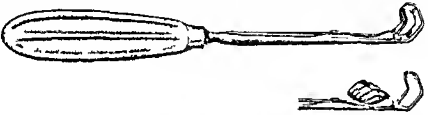


Fig 457 —Sir StClair Thomson's caged curette

the largest size that can be used should be chosen Have ready Luc's or similar grasping forceps to seize the mass if it happens to fall from the cage and remain in the pharynx The mouth is kept widely open by means of a Boyle-Davis or Doyen gag *A finger examines the growth*, and the curette is passed into the nasopharynx and moved upwards until the septum nasi is felt The curette is then pressed firmly up and then back, and the mass of adenoids is removed by one firm sweep of the curette right down the posterior wall of the pharynx The patient is then turned over on to the right side, and a finger is passed into the nasopharynx, which should be found clear of adenoids

CHAPTER LIX

THE LARYNX

By Eric Watson-Williams

METHODS OF EXAMINATION

INDIRECT LARYNGOSCOPY

A round mirror is employed, fixed at 45° at the end of a straight handle a mirror 1 in in diameter serves most purposes Useful instruments are made with a lamp in the handle If a forehead mirror or lamp is used, arrange it to illuminate the back of the pharynx Have ready a supply of 6 in gauze squares The dexterity that comes only with practice, and the greatest gentleness, are essential for success, given these you will be able to examine even small children

Tell the patient to open his mouth widely, to protrude the tongue as far as possible, and to breathe quietly without "trying to show the throat"

A tongue cloth is laid on the fore part of the tongue, and the tongue is firmly held between the examiner's thumb (above) and middle finger (below) of the left hand, the forefinger being placed on the patient's upper lip to keep the moustache, if any, out of the way Hold the tongue firmly, but do not pull. The laryngeal mirror is now passed backwards without touching tongue or tonsils, till it reaches the uvula, which is gently pressed upwards and backwards The mirror then reflects a picture of the larynx (*Fig* 458), the epiglottis appearing in the upper part, the arytenoid cartilages in the lower, and the true and false cords and the ventricles of the larynx in the centre The patient is then requested to say "ee, ee", and thus the true vocal cords are more clearly seen, and their appearance and mobility can be studied Several short examinations are better tolerated than one long one

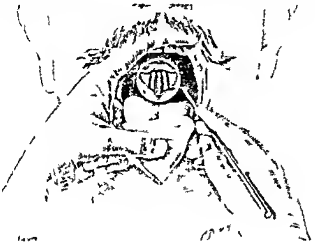
DIRECT LARYNGOSCOPY

Indications —(1) For the examination of the larynx when the indirect method fails, (2) For the removal of an impacted foreign body, (3) In treating any laryngeal obstruction e g, in diphtheria, where it replaces tracheotomy, (4) To insert an intra tracheal catheter

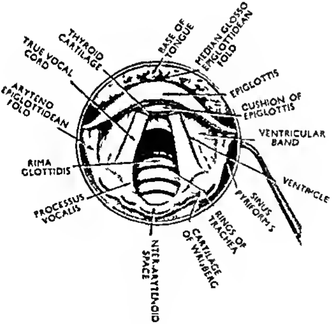
Anæsthesia —Children under 3 years old can be examined by the direct method without any anæsthetic *General anæsthesia* is advisable in the great majority of cases for those without special experience Ether vapour from a Shipway apparatus is the most convenient method, oxygen ether entails a real risk of explosion Before starting the anæsthetic make sure that the tracheotomy instruments are *ready* See also that any other instruments you can possibly require are at hand, in working order, and long enough to reach beyond the end of the laryngoscope These should include (1) A saliva tube, attached to the suction apparatus, (2) Wool carriers—be sure that the wool is firmly attached, (3) If a foreign body is suspected, alligator forceps

The Operation —Darken the theatre Place the patient in the supine position with the head extended over the edge of a pillow Pass the laryngoscope (*Fig* 459) back along the dorsum of the tongue, identifying in turn the uvula and then the epiglottis Insert the beak behind the latter and hook it forward

In doing this a lifting movement is needed, the teeth are not to be used as a fulcrum. Additional room may be gained by turning the head to the left side and passing the tube through the right corner of the mouth. As the epiglottis is lifted forward the whole larynx comes into view, gentle pressure on the pomum



A



B

Fig 438.—A, Indirect laryngoscopy, B, Enlargement of the laryngeal image during inspiration

Adami may be needed to reveal the anterior commissure If there is much spasm paint the cords with a wool mop, moist, but not wet, with anæsthetic solution

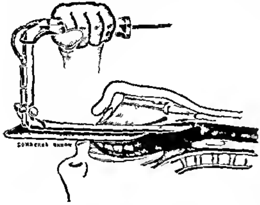


Fig 459.—Author's laryngoscope

LARYNGOTOMY

Indication.—Urgent laryngeal obstruction, except in small children

Instruments Required.—As for tracheotomy (*see below*), but providing a laryngotomy tube (*Fig* 460)

The Operation —*Stabbing the larynx* should be used only in cases of extreme urgency With the patient lying on couch or floor, with head extended, place the left thumb on the thyroid cartilage, pointing towards the sternum, define the upper border of the cricoid by digging the thumb-nail in firmly just above it Make a transverse incision 1 in long, level with this border, again define, and stab directly backwards through the cricothyroid membrane Separate the margins of the cut by inserting the handle of the scalpel and turning it Now arrange a pillow under the shoulders, so that blood does not run down the trachea, and insert a laryngotomy tube in the opening A small tracheotomy tube, or a piece of drainage tube (with safety-pin to prevent its being sucked in) may be used Whatever is used, fix it so that it cannot be coughed out Finally, arrest any bleeding from the small veins sometimes encountered, and apply dressing

Fig 460.

When the patient is not threatened with immediate asphyxia, anæsthesia should be procured by infiltrating the superficial fascia over the larynx with a 1 per cent novocain solution Make a transverse incision at the level described above, but rather longer Define the midline and retract the muscles outwards The lower part of the cricothyroid membrane comes into view puncture this with a scalpel, keeping close to the cricoid cartilage to avoid the cricothyroid artery Do not make too wide an incision if the tube fits tightly it will prevent blood from entering the trachea Pass the tube with its pilot directly backwards and downwards, remove the pilot, tie the tapes firmly, and insert a stitch on either side to close the skin incision, if the laryngotomy tube is provided with an inner tube, insert this, and apply a plain gauze dressing, notched above so that it may be drawn up over the wound on each side of the tube

TRACHEOTOMY

Instruments Required—Tracheotomy may be an operation of urgency it is a good rule to keep a complete set of the instruments required in one receptacle, so that everything wanted will be at hand without delay Two scalpels (see that they are sharp), two pairs of dissecting forceps, four pairs of Spencer Wells pressure forceps, straight scissors, tracheal dilator, Parker's tracheotomy

tubes (4 sizes), needles, silk, silkworm gut, tape, feathers, small-bore cannula, with tubing to attach to suction apparatus

Anæsthesia —Avoid general anæsthesia in the presence of severe respiratory obstruction Local anæsthesia as described for laryngotomy is safe a larger amount of anæsthetic may be necessary, as the skin incision is longer. With very small children the best plan is to insert an intratracheal catheter by direct laryngoscopy, a few whiffs of ethyl chloride may be given through the catheter for the tracheotomy When dyspnœa is not severe a general anæsthetic is permissible, chloroform is preferable to ether

The Operation —The patient lies on his back with a firm pillow under his shoulders, the neck being thus fully extended He should be put in this position before the anæsthesia is commenced, and should not be moved afterwards

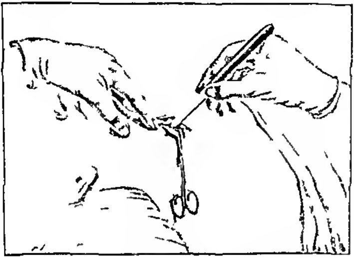


Fig 461 —Tracheotomy opening the trachea

If there is plenty of time, use a 'collar' incision, three inches long, half an inch below the cricoid, and slightly concave upward, choose a natural crease if one is visible Reflect skin and superficial fascia up and down, to expose the deep fascia If time presses, or the patient's neck is short and fat, the operator should, with his left hand, define the larynx and cricoid cartilage, then, lightly grasping the larynx with the thumb and second finger of the left hand, the index finger being placed in the middle line on the cricoid cartilage, a free incision is made from the cricoid down to just above the suprasternal notch This incision should divide the skin and superficial fascia The middle line being again accurately determined, a further incision divides the deep fascia Retract laterally the muscles in front of the trachea and pick up any bleeding points with pressure forceps These pressure forceps are allowed to hang down on either side, and act as retractors The isthmus of the thyroid gland is seen at this stage pass a closed hæmostat behind it, to free it from the trachea, and clamp it with a pair of forceps on either side of the midline and divide it between them Make sure that the front of the trachea is completely cleared, and that bleeding is arrested Enter the knife, edge upwards, into the trachea below the 3rd ring, and carry it firmly upwards, dividing the 3rd and 2nd rings but not the 1st (*Fig* 461) As a

rule the opening of the trachea is followed by violent coughing by the patient The tracheal dilator is at once inserted, and a short period is allowed to elapse during which the patient clears the trachea of blood and membrane, assisted by suction The outer part of the tracheotomy tube is then inserted into the trachea, and tied by tapes around the neck The wound is closed by sutures

The operation is one requiring some nerve and a level head It may be somewhat difficult in a small fat baby, with violent tracheal excursions and congested veins There must be no hurry and no clumsiness Every step must be done in order, and no effort made to open the trachea till its rings are exposed Open the trachea slowly and quietly Once the trachea is open and the dilator in position, the object of the operation is obtained, and the introduction of the tube can be done at leisure If respiration ceases before the trachea is opened, complete the opening and insert the dilators *before artificial respiration is started* The passage of a feather into the trachea will often start respiration Always pass the tracheotomy tube between the blades of the dilator this will ensure that the tube shall be placed within the trachea

When operating on adults, it is often a wise plan to remove a quarter of an inch of one or, if necessary, two tracheal rings, making the incision to one side of the midline, so that a small oval of tracheal wall is completely removed When the neck is short and fat, Durham's 'lobster tail' tube is often much more easily inserted and retained than Parker's If laryngeal obstruction has been present for several weeks do not insert a wide bore tube at once, a small bore (22 mm circumference) should be used for two or three days to avoid pulmonary œdema With elderly patients remember that the rings may be ossified and require division with stout scissors

After-care.—A special nurse is essential she must not leave the patient unattended on any account until he has become accustomed to being unable to speak a bell and a writing tablet may then be substituted For the first forty-eight hours the old fashioned steam-tent offers great advantages in nursing babies or elderly patients The inner tube must be removed and cleaned frequently—before it becomes half blocked with discharges the outer tube should not be changed for the first three days unless the danger is over

CHAPTER LX

THE EAR

By R Scott Stevenson

EXAMINATION

The prelude to instrumental examination should be inspection of the auricle and, after the pinna has been turned forward, inspection and palpation of the mastoid region

The Use of the Otoscope—For those who have not had the advantage of holding an appointment in an ear, nose, and throat department, the electric otoscope (*Fig* 462) will be found more generally helpful than the head mirror and naked speculum The electric otoscope is simple to use The largest speculum which will enter the meatus comfortably is selected and connected to the otoscope, the light is then switched on The auricle is pulled backwards to straighten the natural curve of the meatus and the instrument is inserted gently, remembering that the meatus is sensitive The speculum is introduced for only about half an inch and no force is used The view of the drumhead may be obstructed by wax, debris, or pus, if this is the case preliminary syringing and gentle mopping with cotton-wool is essential

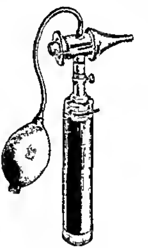


Fig 462—An electric otoscope

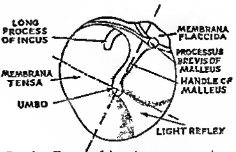


Fig 463—Diagram of the right tympanic membrane as viewed through the electric otoscope

It is easy to mistake the *upper and inner part of the meatus for the drumhead*, but the pearly-grey colour of the membrane is characteristic The chief landmark of the drum is the handle of the malleus, which resembles the hands of a clock at five minutes past one (in the right ear, *Fig* 463) and five minutes to eleven (in the left ear), though its lower extremity is rather lower than the middle of the drumhead From the lower tip a definite cone of light passes downwards and forwards to the circumference of the membrane Sometimes the membrane is indrawn and the appearance of the malleus exaggerated, or the membrane may be scarred, or white calcareous patches present in it When the membrane is

reddened and swollen, of if a perforation or granulations are present, careful note must be made of these facts When it is doubtful whether a small perforation is present, the membrane may be moved to and fro by the aid of the rubber bulb attached to the otoscope, the speculum must fit closely into the meatus, the large lens fitted and the rubber ball alternately compressed and released, so that the air in the external meatus is similarly alternately condensed and rarefied, Normally the membrane will be seen to move to and fro, but when a perforation is present there will be no such movement While examining the drumhead do not forget to look at its uppermost part, i e, above the handle of the malleus Here is Shrapnell's membrane (membrana flaccida) There may be a small perforation in this membrane denoting attic suppuration whereas the main part of the drumhead is normal Sometimes the patent's head has to be tilted in order to see Shrapnell's membrane properly

SYRINGING THE EAR

Cerumen is recognized as a brown, black, or grey mass blocking the ear passage Forcible syringing must never be employed. If the wax is hard and there is any difficulty in removing it, it is wiser to delay a day or two to instil morning and evening five to ten drops of liquid paraffin or a similar amount of the following prescription —

℞	Sod Bicarb	gr 15
	Glycerini	♏ 120
	Aq Dest	ad ♏ 240 (half an ounce)

The patient should be seated A towel or mackintosh is fastened round his neck, a kidney dish held to the ear by the patient, with its edge under the lobule and the auricle is pulled back by the left hand to straighten the meatus (*Fig* 464), The best solution is one of bicarbonate of soda at 100° F With ordinary care the usual metal ear syringe will never cause harm After the syringe has been filled with lotion it is pointed upwards and any air in it is expelled The right hand only is employed in holding the syringe and the nozzle points just within the meatus, directed towards the roof or the floor On no account must it be inserted deeply into the meatus or pointed towards the drum head After the wax has been expelled, the meatus is mopped dry with pledgets of cotton wool and the ear is again inspected with the otoscope The drumhead is moved to and fro by means of the attached rubber ball, which as a rule soon removes any sensation of discomfort and stuffiness in the ear

Fig 464 —Method of syr nging the ear

EXTERNAL OTITIS

External otitis is often associated with eczema of the pinna, or of the skin behind the ear or of the scalp One must first ascertain whether the infection is confined to the external auditory meatus

Treatment —It is important not to use strong antiseptics First of all the debris in the external meatus should be removed by syringing When the meatus is clear, the drumhead is examined to ascertain whether there is a perforation of the tympanic membrane Squeezing the rubber bulb attached to the otoscope may cause pus to exude from a small perforation When there is middle ear suppuration the external otitis will probably abate if this underlying cause can be removed When there is no such underlying cause, local treatment by swabbing the inflamed area with 10 per cent ichthyol in equal parts of glycerin and water or 10 per cent argyrol is useful One per cent silver nitrate dissolved in spirit of nitrous ether is helpful in some persistent cases One of these solutions should be applied daily, *ointments must be avoided*, and the *patient warned* that on no account is he to touch his ear with anything except his elbow !

FURUNCULOSIS

The differential diagnosis between furunculosis of the external auditory meatus and mastoiditis is sometimes difficult, and unless the clinician feels assured *that he is dealing with a boil, a second opinion should be sought* Treatment in most cases is conservative A strip of ½-in gauze soaked in a saturated solution of magnesium sulphate in glycerin is inserted into the meatus This should be changed daily After three days this dressing is inclined to make the skin sore and a similar wick soaked in 10 per cent ichthyol in glycerin should be substituted For the pain heat is comforting, but it should be dry—a hot water bottle is efficient, if it is available, short wave diathermy is a useful method of applying heat Under this regime the boil usually bursts into the meatus In order to prevent recurrence, treatment should continue after the boil has burst During the final stages, in order to harden the skin, the wick is wrung out of surgical spirit

Exostosis may be confused with a boil in the ear When examined with the otoscope an exostosis appears as a yellowish white excrescence, standing out from the deeper part of the external meatus, usually where the bony and cartilaginous parts meet Exostoses are often multiple, and the diagnosis is confirmed by touching them with a probe, when the characteristic hardness is noticed Unless an exostosis is causing serious blockage to the ear passage, it should be left alone

TRAUMATIC RUPTURE OF THE DRUMHEAD

There is no doubt that the ears are protected from the effect of explosions by wearing ear plugs, but no type of plug is any better than cotton wool moistened with vaseline or (in an emergency) soap Recent traumatic rupture of the drum requires no active treatment, and any syringing, lavage, or instillation of drops should be forbidden, as such treatment interferes with the sealing of a *perforation by blood clot, which should not be disturbed but allowed to dry* A ruptured drumhead soon heals, and after a week the dried clot may be removed by forceps or a cotton wool mop If suppuration ensues this must be treated as described on p 425 Hæmorrhage from the ear, after an explosion, may sometimes be due to bleeding from granulations or from the surface of the tympanum exposed through an old perforation, so a careful examination by the otoscope must always be made In the Services many cases of deafness or bleeding from the ear are attributed to explosions or gun fire, quite genuinely, when an old chronic otitis of one type or another is actually present

Labyrinthine Concussion may be the cause of deafness after an explosion without any rupture of the drumhead It is usually accompanied by tinnitus and sometimes giddiness, but gradually improves with time unless there is some actual labyrinthine lesion, the detection of which requires an experienced otologist

ACUTE OTITIS MEDIA

On examining the ear with the otoscope, the drumhead in the early stages is seen to be congested, later it becomes purplish-red and bulges The introduction of the sulphonamide drugs has changed the outlook in such cases Nearly all are caused by the streptococcus or the pneumococcus, so treatment with sulphapyridine (M & B 693) should be instituted as soon as a diagnosis is made, there is no particular advantage in preferring sulphanilamide, as it is but little less toxic and has no effect on the pneumococcus The usual initial dose for an adult is 2 g (4 tablets), followed in four hours by a further 2 g, and thereafter 1 g (2 tablets) every four hours until the temperature has been normal for 24 hours During this period the patient must be under constant supervision, as the drug is a potent one and complications, slight or severe, from its use are not uncommon Many cases of acute otitis media abort under this treatment, but not all, and paracentesis is by no means obsolete If the patient has had a bad night I am disinclined to let him have another bad night and prefer to incise the drum, but whether this really ever "prevents a mastoid operation" is debatable In some cases treated by sulphapyridine the middle ear is still full of pus and the drum bulging, though pain has disappeared and the temperature has fallen to normal, in such cases paracentesis should be done for purposes of drainage Even an acute mastoiditis under sulphapyridine treatment, so that signs and symptoms of the inflammation have disappeared and the temperature and pulse rate fallen to normal, may require operation two or three weeks later, which will reveal the mastoid cells broken down and full of pus

Paracentesis is a bad term, for the drumhead is not punctured but incised The operation can be carried out by any doctor accustomed to the electric otoscope The glass end of the instrument is removed so that the paracentesis knife can be passed down the speculum. The type of knife shown in

Fig 465.—Fagge's myringotome

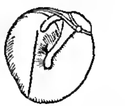


Fig 466.—Showing site of incision through the tympanic membrane (paracentesis tympani).

Fig 465 will be found efficient A general anæsthetic is desirable, preferably nitrous oxide or evipan, in children, however, a few drops of 20 per cent cocaine, warmed and instilled into the ear, can be employed as a local anæsthetic. It is true that cocaine solutions will not produce perfect anæsthesia in this instance, but they dull the drumhead sufficiently to carry out the operation with only momentary pain.

Technique—The external meatus is mopped out with 2 per cent picric acid or surgical spirit The largest size of speculum which will fit the external meatus is placed in the otoscope and the drumhead examined carefully Maintaining a good view of the drum, an incision is made just behind the handle of the malleus, through the tympanic membrane right down to the floor of the meatus (*Fig* 466) The field becomes obscured by blood and pus, this is mopped out When the bleeding has abated, pus in the middle ear is sucked out with the aid of the rubber bulb attached to the otoscope The external meatus is mopped

dry and a strip of gauze placed in it For the next few days 2½ per cent carbolic acid in glycerin should be instilled into the ear night and morning

OTITIS MEDIA IN INFANTS

Post mortem examination in infants dead from obscure conditions shows a high percentage of middle ear suppuration, which was not suspected during life If is evident that when the diagnosis is obscure, examination of an infant should not be considered complete without an examination of the drumhead When symptoms of meningeal irritation are present, even if no acute inflammation of the middle ear can be diagnosed, it is often desirable to carry out paracentesis, and it has been found that this gives relief to meningeal symptoms It is far wiser to do such a paracentesis early than to wait for definite ear symptoms to develop

CHRONIC SUPPURATIVE OTITIS MEDIA

A discharging ear should be cleansed The first step is to ascertain whether the discharge is coming from the middle ear or whether the condition is due to an external otitis

When the external meatus has been mopped clear the drumhead is examined, and in cases of chronic otitis media the perforation will usually be seen Perforations may be large or small, marginal or central, and sometimes granulations or a polypus may be present If the perforation is a large one and drainage is adequate, the condition is not usually difficult to cure with efficient treatment, it is when the perforation is small, particularly if it is high up (attic perforation) or marginal, that conservative treatment, however thorough, may prove ineffective A polypus should always be removed before commencing local treatment

Removal of a Polypus—A snare is employed It must be emphasized that the snare is used to cut through the base of the polypus, it must never be used to pull a polypus out by its root The attached polypus having been removed any granulations should be touched with silver nitrate

Discharging Ear: Routine Conservative Treatment—The popular treatment of middle ear suppuration by hydrogen peroxide drops should not be employed If the skin of the external meatus is excoriated from irritation of the discharge, 2½ per cent carbolic acid in glycerin drops are employed for a day or two, otherwise I have found the most effective treatment to be daily mopping out of the discharge and blowing in iodine and boric powder The first time this method is employed the external meatus is cleansed right down to the perforation in the drumhead With the aid of a Eustachian catheter the middle ear is inflated, blowing the discharge still in the tympanic cavity out through the perforation, this discharge is also mopped out The iodine and boric powder is blown into the middle ear by means of a simple powder blower (*Fig* 467) and the patient is instructed to mop out the ear each day and continue to blow in the powder once daily The patient should be seen at least once a week, to check that the treatment is being carried out effectively If the nose and throat are healthy, this method of treatment

Fig 467—All glass powder blower for use in chronic suppurative otitis media. The bottle is kept stoppered when not in use (*Made by Down Bros*)

conscientiously carried out will cure in a comparatively short time many cases of chronic middle ear suppuration of even several years' duration If a cure is not effected in several weeks of this treatment, a mastoid operation is usually indicated The following is the prescription for the iodine and boric powder —

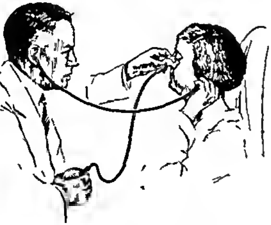
℞	Iodi Resublimati	gr 4
	Pulv Acid Boric	gr 480 (one ounce)

Rub down the iodine crystals with a few drops of spirit vini rect until solution is effected, and gradually incorporate the finely powdered boric acid The powder should be used freshly prepared and kept in a stoppered bottle to prevent volatilization of the iodine

DEAFNESS

Deafness may be due to impacted wax, to obstruction of the middle ear by catarrh, inflammation, or suppuration, to otosclerosis, or to nerve deafness affecting either the cochlea or the acoustic nerve The first step in the examination is to exclude the presence of wax If not due to wax, the drumhead is examined, noting if it is indrawn scarred, or has a perforation

Hearing Tests —If the drumhead is intact, the patient's hearing is tested by the voice and the tuning fork Both ears are tested with the ordinary conversational voice and with a whisper A normal person should be able to hear a whisper at twenty feet A doctor who is not an otologist need use only C 256 tuning fork (middle C of the piano) After knocking the tuning fork on his own patella, the clinician first holds it one inch from the external meatus, then in a couple of seconds he places the base of the tuning fork on the mastoid process



A B

Fig 468 —Politzerization A Lennox Browne's modification of Politzer's bag B Auscultation tube

If the patient hears the first (air conduction) better than the second (bone conduction) Rinne's test is said to be positive This is normal When bone conduction is better than air conduction, Rinne's test is negative If bone conduction is appreciably better than air conduction, some form of middle ear deafness is present When the patient is a young woman and the drumheads appear to be normal, deafness is likely to be due to otosclerosis If deafness improves after inflation of the middle ear, it is very unlikely that the deafness is due to otosclerosis, the case is probably one of catarrhal deafness Inflation of the middle ear is a method of diagnosis as well as treatment, and is carried out by Politzer's method or by Eustachian catheterization

Politzerization (*Fig* 468)—Lennox Browne's modification of Politzer's bag (*Fig* 468, A) has a long rubber tube attached, and consequently is much easier to use than the original model One end of the auscultation tube (*Fig* 468, B) is placed in the patient's ear and held there by him, the examiner places the other end in his own ear A rubber nozzle connected to the Politzer bag is inserted into the patient's nostril on the side which is being examined and held in position by the examiner's forefinger and thumb, which at the same time close the other nostril The patient is instructed to blow out his cheek as if he were going to blow a trumpet, as he does so, the examiner firmly and suddenly compresses the rubber bag When inflation is carried out successfully, air enters the Eustachian tube and the middle ear, and a characteristic blowing sound is heard, sometimes the sound is crackling or bubbling, due to a catarrhal condition of the Eustachian tube or middle ear

Eustachian Catheterization—This is a more exact method than the foregoing *To pass a Eustachian catheter successfully requires practice* The patient's nostrils are swabbed or sprayed with a little 5 per cent cocaine solution

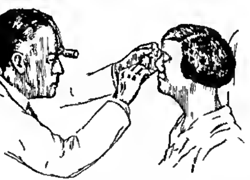


Fig 469—Passing a Eustachian catheter

After waiting several minutes, a nasal speculum is inserted with the headlight directed into the nostril (*Fig* 469) The Eustachian catheter is held with its beak turned downwards and its ringed end between the thumb and the first finger *It must be remembered that the floor of the nasal passage is horizontal* The tip of the catheter is pushed along the floor until it begins to glide downwards towards the soft palate It is then rotated outwards so that the beak touches under the posterior end of the inferior turbinal until the ring at the outer end points towards the eye on the side which is being catheterized In ordinary circumstances the tip of the catbeter should now be within the opening of the

Eustachian tube (*Fig* 470), but sometimes two or three attempts have to be made before the tip engages the opening When the catheter is in position it should be held in the examiner's left hand and not moved until the inflation has been carried out The vulcanite connexion is fixed into the end of the catheter and the bag is compressed gently When inflation has been carried out successfully, by means of the auscultation tube, air can be heard entering the middle ear If the characteristic blowing sound is not heard, the Eustachian catheter should be moved slightly forwards or backwards and the process repeated When inflation is not successful after two or three attempts, the Eustachian catheter should be withdrawn and the procedure started afresh

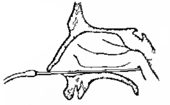


Fig 470—Eustachian catheter in position and connected to the inflation apparatus

Deafness due to acute catarrh or inflammation should never be treated by inflation Deafness resulting from recent catarrh which has subsided will usually clear up after several treatments by one of these inflation methods

FOREIGN BODIES

Most foreign bodies can be removed from the ear by syringing When this is not the case and the patient is a child, a general anæsthetic is indicated Care and gentleness are essential A small blunt hook or a probe with a large eye will usually be more useful than forceps The end of the hook is insinuated between the foreign body and the meatal wall, turned, and withdrawn, bringing the object with it Especially when it has become deeply impacted, it may be necessary to remove the foreign body by an incision akin to a mastoid incision through the cartilaginous meatus behind the ear When an incision has to be made it is best to admit the patient to the ward

HÆMATOMA OF THE AURICLE

If seen early the blood may be aspirated It is best to evacuate the blood through a small incision A troublesome complication is the supervention of infection If perichondritis and suppuration have resulted, free incision right through the auricle should be carried out

THE AFTER-TREATMENT OF MASTOID OPERATIONS

There is rarely much pain after the simple mastoid operation, the patient is usually quite ready for breakfast the morning after the operation On that day the outer dressing, which is probably soaked with blood, should be changed without interfering with the layer of gauze next to the skin Unless there is a rise of temperature, the inner layer need not be changed until the fourth day When there is a rise in temperature, all dressings should be removed and one or two stitches taken out from the lower part of the wound Some aural surgeons leave the posterior wound open and continue to pack it for two or three weeks, others put in a rubber tube from the mastoid antrum to the lower end of the wound, stitching the skin incision for three-quarters of its length My own practice is to swab out the mastoid cavity with bipp and place a ½ in strip of gauze, moistened with the paste, leading from the mastoid antrum out of the lower end of the wound, and stitch up the remainder of the skin I am prepared to remove the drain and some of the stitches before the fourth day if the patient's

condition appears to demand this Otherwise the less after-treatment the mastoid area receives the better Usually the whole dressing is removed for the first time on the fourth day and then a dry dressing is applied, which is left on until the sixth or seventh day, when the remaining stitches are removed A gauze wick dipped in bipp is packed into the external meatus at the time of operation and renewed when the dressing is changed, this prevents its collapsing and narrowing

Similarly with the radical mastoid operation, after-treatment should be reduced to a minimum A wide-bore rubber tube is placed in the enlarged external meatus at the time of the operation This is left untouched until the fourth day On that day the bipped gauze drain at the lower end of the posterior wound is removed and also a bipped gauze drain which has been placed in the rubber tube in the external meatus The rubber tube is turned so as to prevent its sticking to the skin, and a little iodine and boric powder blown into the cavity On the sixth or seventh day the dressings and the stitches are removed from the posterior wound and the rubber tube is shortened by a quarter of an inch It is removed altogether about the tenth day, when iodine and boric powder is again insufflated Keeping a wide bore rubber tube in until the tenth day prevents contraction of the external meatus, which is otherwise likely to follow the cutting of a meatal flap in the radial operation Thereafter the cavity is inspected daily, any granulations are touched with silver nitrate, and iodine and boric powder insufflated freely The patient should be fit to leave hospital by the end of three weeks

CHAPTER LXI

THE EYE

By F A Williamson-Noble

AFFECTIONS OF THE EYELID

Wounds of the Eyelid —Wounds of the eyelid, when they do not involve the lid margin, usually heal readily They should be carefully cleansed, and the finest silkworm-gut used for stitches When the lid margin is involved, and especially if the wound is at all a ragged one, it must always be borne in mind that restoration of a neat margin is the most important thing to aim at, and that the marginal stitch should therefore be inserted first In doing this, care should be taken to see that there is no inversion of the skin on either side, as this may result in an ingrowing eyelash, which, rubbing on the cornea, would give rise to constant irritation

Inflammations of the Lid Margins —Inflammation in the hair follicles and in the sebaceous and sweat glands which open into the hair follicles is a very common disease in children (ciliary blepharitis) An error of refraction is in most cases the main predisposing cause In treating this condition, it is to be borne in mind that the real seat of the disease is in the depths of the hair follicles, and not on the surface, and that before any application can reach this point, as much as possible of the surface exudate must be dissolved In slighter cases it usually suffices to bathe with a warm alkaline lotion until all the crusts have been dissolved, and to rub in a very dilute ointment of nitrate of mercury (1–10 B P strength) In more severe cases it is advisable to pull out the lashes in the most affected part, to clip off the others, and then, after bathing thoroughly, to touch the whole of the row of hair follicles with mitigated silver stick Another excellent method is to substitute for the mitigated stick thorough scrubbing with 25 per cent protargol In older people a similar condition is often produced by the organism which causes chronic angular conjunctivitis (diplobacillus of Morax) For this type of inflammation, a lotion containing ¼ per cent zinc sulphate, and a cream made up of zinc oxide, lanolin, and olive oil, are best —

℞	Zinci Oxidi	gr x	Olei Olivæ	℥ii
	Liq Calcis	♏x	Lanolini	ad ℥i

Hordeolum (Stye) —Early fomentation will sometimes bring about resolution As soon as the little abscess points, it should be pricked and ' hot bathed ' Hot bathing is performed by the patient himself in the following manner —

> A teaspoonful of boric acid crystals is put into a bowl and a pint of nearly boiling water is added He is given a wooden spoon with cotton wool wound round the lower end, and he dips the latter into the hot lotion and then holds it up against his closed eye The saturated cotton wool should be as hot as the patient can bear, and as soon as it cools he should dip it in again continuing the process for a quarter of an hour At the end of this period a pad of warm cotton wool is applied to the eye and kept in place with a bandage If necessary the procedure may be repeated three times daily

As most of these cases are due to staphylococcal infections, stannoxyl given internally is sometimes beneficial

Epilation.—It occasionally happens, especially in cases of old-standing trachoma, that some of the eyelashes, instead of growing out, become inverted, so that they rub on the cornea or conjunctiva and keep up a constant irritation The condition is known as trichiasis The removal of these eyelashes is best performed with special flat-pointed epilation forceps (*Fig* 471) No jerking is required, a firm, gentle pull bringing the hairs away easily and with little pain If they are few in number, they may be killed by electrolysis, but when the trichiasis is marked, or associated with any degree of entropion, special operative methods are required

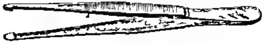


Fig 471 —Flat pointed epilation forceps

Meibomian Cysts (Tarsal Cyst, Chalazion).—Often a cyst, or cysts, last for many months without producing pain or any other symptom beyond the deformity of the lid The treatment consists of incision and free curetting Evert the lid and apply one or two crystals of solid cocaine over the conjunctival surface of the swelling Leave it to act for two minutes, then with a fine-needled hypodermic syringe inject *into the cyst* about 5 min of 2 per cent cocaine in 1–5000 adrenaline Let this again act for two minutes With a Beer's knife (*Fig* 472) make a vertical incision through the wall of the conjunctiva (*Fig* 473), and then thoroughly scrape away with a small curette all the gelatinous and diseased tissue from the walls of the cyst It is best to apply a pad and bandage for twenty-four hours, and to have the eye bathed frequently with boric lotion for some days

Fig 472 —Beer's knife

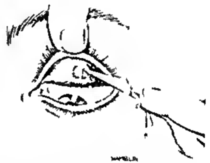


Fig 473 —Incision of Meibomian cyst (chalazion) of upper lid. The lid has been everted and the cyst is being opened by a vertical incision with a Beer's knife

AFFECTIONS OF THE CONJUNCTIVA

Injuries to the Conjunctiva.—When uncomplicated by injuries to other structures, these usually heal readily Small tears are best left alone Even extensive tears seldom require more than one stitch

A subconjunctival hæmorrhage looks alarming but is of little consequence, and beyond the prescription of hot boric acid bathing usually requires no treatment

Foreign bodies, if not at once washed away by the flow of tears, usually obtain a lodgement under the upper eyelid and become embedded in the conjunctiva there To find them it is necessary to evert the upper eyelid They should be removed with a small piece of moist lint.

To Evert the Upper Eyelid—The examination of the lower conjunctival fornix is simple The patient looks up, the lower lid is pulled downwards, and gentle pressure backwards will then reveal it in its whole extent To get a similarly good view of the upper fornix requires the knowledge of a little manœuvre very readily acquired and yet

very frequently bungled The method I adopt requires the use of only one hand, leaving the other free for any purpose, such as painting the lids First of all persuade the patient to look steadily downwards at the floor or at his own hands, with the head thrown slightly backwards, then place the ulnar border of the index finger on the upper lid immediately above the margin of the tarsal plate, the thumb is placed on the lower lid, pressing it gently back The index finger then gently presses the margin of the eyelid down on to the thumb, and by a slight movement the thumb completes the eversion Straight pressure backwards on the eyeball will then bring the folds of the upper fornix into view Standing in front of the patient, use the right hand for the left eye, and vice versa

Treatment of Acute Conjunctivitis.—The main essentials are efficient and regular cleansing with some simple aseptic lotion The lotion should produce as little irritation as possible, and should be used as warm as it can be with comfort, and in no niggardly fashion A weak boric acid lotion in most cases fulfills these requisites, but where it produces irritation, as it sometimes does, it is best to substitute normal saline The comfort produced by the free use of lotions is probably almost entirely due to the freeing of the conjunctival sac from portions of desquamated epithelium and flakes of pus, which act as irritants like any other foreign body In mild cases this cleansing of the eye and the prescription of a simple ointment to prevent gumming of the lids is all the treatment required In more acute cases, nothing can replace the salts of silver in efficacy, and for certainty and efficiency silver nitrate is still the best

Fig 474 —Application of silver nitrate solution to the conjunctiva of everted upper lid (*see* text)

When we brush the conjunctiva of the everted lids with silver nitrate (*Fig* 474) in a 1 or 2 per cent solution, what we first notice is that a faint bluish-white pellicle forms on the conjunctiva For the next two or three hours there is an increase in the amount of secretion from the eyes, and the eyes seem to feel even more gritty than before, after this period they feel cooler and more comfortable than at any time since the inflammation commenced

Silver nitrate solution should never be dropped into the eye, but always painted on to the conjunctiva of the everted lids As a general rule, I should recommend that an interval of at least twenty-four hours be allowed to elapse between any two successive applications

The great irritation caused by the use of silver nitrate has led to numerous attempts to replace the violently irritant inorganic acid radical by some non-irritant organic acid Many of these preparations exist, such as protargol, collargol, and argyrol My personal preference is distinctly in favour of argyrol, used in strengths varying from 10 to 25 per cent, and it is in this form that I always prescribe silver salts when I give them to patients for home use

Acute Purulent Conjunctivitis (Blennorrhœa).*—Ophthalmia neonatorum usually commences on the third to the fifth day after birth After washing away the secretion and examining the cornea, the conjunctival fornices are brushed out with a weak silver nitrate solution (1 per cent).

* This condition, both in children and adults, is best treated by sulphonamide therapy (*see* Chapter L)

The best method of examining a young child s eye is to sit opposite the nurse, who holds the child's body and hands close down to its sides, the head being grasped in a towel between the surgeon s knees After carefully washing away all secretion, the cornea is examined If necessary, the lids must be retracted with small bent-wire retractors Sometimes even with retractors it is difficult to get a view of the cornea, as it tends to roll upwards in the effort to shut the eyes By gently increasing the pressure of the lower retractor downwards and backwards, and pulling on the upper retractor, a view can usually be obtained *It is imperative not to use ill applied force in these cases,* as there is always a danger of causing a perforation in a badly affected cornea

If the cornea is not affected, a lotion of perchloride of mercury (1–6000) is prescribed to be used freely and frequently The nurse or mother should be instructed *that the lotion must get inside the lids, and that all the secretion must* be washed away at each bathing The intervals between bathing should not be longer than two hours

If the cornea is affected, it is advisable to substitute a weak boric acid lotion for the mercuric lotion, and to put in after each daily painting a small piece of atropine ointment (1 per cent)

The eyes should never on any account be bandaged or covered up The secretion must be allowed a free escape

In examining or treating any case of purulent ophthalmia, both nurse and house surgeon should wear goggles and rubber gloves

Gonorrhœal Conjunctivitis in the Adult —This form is mostly associated with urethritis, and is due to direct infection It most frequently commences in the right eye *in right-handed people, and one of the first duties of* the house surgeon is to take measures to prevent the healthy eye being affected To effect this, the inflamed eye should be covered with a pad soaked in some antiseptic lotion (1–2000 perchloride of mercury) The skin and lids of the healthy eye should be cleaned and scrubbed gently with lotion of the same strength, and the eye itself irrigated with a mild boric acid lotion A Buller's shield (*Fig* 475) should then be applied and carefully fastened down all round, except for a space at the outer part of the orbit, which is left for ventilation

Fig 475 —Buller s shield.

Having secured the healthy eye against infection, the affected eye can next be dealt with The lid œdema and congestion may be so great that no view can be obtained of the cornea, and only chemotic (œdematous) conjunctiva can be seen projecting through the inflamed lid margins In such a case there must be no hesitation in slitting up the outer canthus with a stout pair of scissors This, with one or two free incisions into the œdematous conjunctiva, will do much *to lessen the congestion,* which if unrelieved *may actually give rise to sloughing* of the cornea through strangulation Frequently changed fomentations, with free irrigation of the eye at each change, must then be ordered, and at the same time a free purging with calomel, followed by a saline aperient If the pain is very great, sometimes more relief is obtained by using iced compresses and iced *lotions for* bathing The lotion used should not be *stronger than 1–10,000* perchloride of mercury In cases where the congestion is as great as the one described, it is not advisable to use silver nitrate until the congestion has been considerably reduced In milder cases the conjunctiva is brushed over, after irrigation, with 2 per cent silver nitrate (*see* p 432 for precautions) The eye

very frequently bungled The method I adopt requires the use of only one hand, leaving the other free for any purpose, such as painting the lids First of all persuade the patient to look steadily downwards at the floor or at his own hands, with the head thrown slightly backwards, then place the ulnar border of the index finger on the upper lid immediately above the margin of the tarsal plate; the thumb is placed on the lower lid, pressing it gently back The index finger then gently presses the margin of the eyelid down on to the thumb, and by a slight movement the thumb completes the eversion Straight pressure backwards on the eyeball will then bring the folds of the upper fornix into view Standing in front of the patient, use the right hand for the left eye, and vice versa

Treatment of Acute Conjunctivitis.—The main essentials are efficient and regular cleansing with some simple aseptic lotion The lotion should produce as little irritation as possible, and should be used as warm as it can be with comfort, and in no niggardly fashion A weak boric acid lotion in most cases fulfills these requisites, but where it produces irritation, as it sometimes does, it is best to substitute normal saline The comfort produced by the free use of lotions is probably almost entirely due to the freeing of the conjunctival sac from portions of desquamated epithelium and flakes of pus, which act as irritants like any other foreign body. In mild cases this cleansing of the eye and the prescription of a simple ointment to prevent gumming of the lids is all the treatment required In more acute cases, nothing can replace the salts of silver in efficacy, and for certainty and efficiency silver nitrate is still the best

Fig 474 —Application of silver nitrate solution to the conjunctiva of everted upper lid (*see* text)

When we brush the conjunctiva of the everted lids with silver nitrate (*Fig* 474) in a 1 or 2 per cent solution, what we first notice is that a faint bluish-white pellicle forms on the conjunctiva For the next two or three hours there is an increase in the amount of secretion from the eyes, and the eyes seem to feel even more gritty than before; after this period they feel cooler and more comfortable than at any time since the inflammation commenced

Silver nitrate solution should never be dropped into the eye, but always painted on to the conjunctiva of the everted lids As a general rule, I should recommend that an interval of at least twenty-four hours be allowed to elapse between any two successive applications

The great irritation caused by the use of silver nitrate has led to numerous attempts to replace the violently irritant inorganic acid radical by some non irritant organic acid Many of these preparations exist, such as protargol, collargol, and argyrol My personal preference is distinctly in favour of argyrol, used in strengths varying from 10 to 25 per cent, and it is in this form that I always prescribe silver salts when I give them to patients for home use

Acute Purulent Conjunctivitis (Blennorrhœa).*—Ophthalmia neonatorum usually commences on the third to the fifth day after birth After washing away the secretion and examining the cornea, the conjunctival fornices are brushed out with a weak silver nitrate solution (1 per cent)

* This condition, both in children and adults, is best treated by sulphonamide therapy (*see* Chapter L)

The best method of examining a young child's eye is to sit opposite the nurse, who holds the child's body and hands close down to its sides, the head being grasped in a towel between the surgeon's knees After carefully washing away all secretion, the cornea is examined If necessary, the lids must be retracted with small bent wire retractors Sometimes even with retractors it is difficult to get a view of the cornea, as it tends to roll upwards in the effort to shut the eyes By gently increasing the pressure of the lower retractor downwards and backwards, and pulling on the upper retractor, a view can usually be obtained It is imperative not to use ill applied force in these cases as there is always a danger of causing a perforation in a badly affected cornea

If the cornea is not affected, a lotion of perchloride of mercury (1–6000) is prescribed to be used freely and frequently The nurse or mother should be instructed that the lotion must get inside the lids, and that all the secretion must be washed away at each bathing The intervals between bathing should not be longer than two hours

If the cornea is affected, it is advisable to substitute a weak boric acid lotion for the mercuric lotion, and to put in after each daily painting a small piece of atropine ointment (1 per cent)

The eyes should never on any account be bandaged or covered up The secretion must be allowed a free escape

In examining or treating any case of purulent ophthalmia, both nurse and house surgeon should wear goggles and rubber gloves

Gonorrhœal Conjunctivitis in the Adult—This form is mostly associated with urethritis, and is due to direct infection It most frequently commences in the right eye in right handed people, and one of the first duties of the house surgeon is to take measures to prevent the healthy eye being affected To effect this, the inflamed eye should be covered with a pad soaked in some antiseptic lotion (1–2000 perchloride of mercury) The skin and lids of the healthy eye should be cleaned and scrubbed gently with lotion of the same strength, and the eye itself irrigated with a mild boric acid lotion A Buller's shield (*Fig* 475) should then be applied and carefully fastened down all round, except for a space at the outer part of the orbit, which is left for ventilation

Fig 475—Buller's shield.

Having secured the healthy eye against infection, the affected eye can next be dealt with The lid œdema and congestion may be so great that no view can be obtained of the cornea, and only chemotic (œdematous) conjunctiva can be seen projecting through the inflamed lid margins In such a case there must be no hesitation in slitting up the outer canthus with a stout pair of scissors This, with one or two free incisions into the œdematous conjunctiva, will do much to lessen the congestion, which if unrelieved may actually give rise to sloughing of the cornea through strangulation Frequently changed fomentations, with free irrigation of the eye at each change, must then be ordered, and at the same time a free purging with calomel, followed by a saline aperient If the pain is very great, sometimes more relief is obtained by using iced compresses and iced lotions for bathing The lotion used should not be stronger than 1–10,000 perchloride of mercury In cases where the congestion is as great as the one described, it is not advisable to use silver nitrate until the congestion has been considerably reduced In milder cases the conjunctiva is brushed over, after irrigation, with 2 per cent silver nitrate (*see* p 432 for precautions) The eye

should be irrigated every half hour with a mild boric acid or normal saline solution, and I prefer to use a douche so that a good flow can be directed into the eye The most serious danger arises from corneal complications, so that great care must be exercised not to injure the cornea during any of these manipulations No care, however, will prevent the affection of the cornea in a large percentage of cases When this happens, atropine should at once be used, and mercurial lotions replaced by boric acid or normal saline Boric acid ointment should always be put between the lids and over any raw surface before the patient goes to sleep It is some hindrance to the formation of adhesions The secretion from the eye remains capable of carrying infection as long as there is the slightest trace of inflammation

Chronic Conjunctivitis—The chronic form may be a sequel of acute conjunctivitis, and especially in gouty or rheumatic subjects the conjunctiva tends to remain in a slightly inflamed condition Mildly astringent lotions, e g, of zinc sulphate (1 or 2 gr to the ounce) or of boric acid with hazeline (20 min to the ounce), are usually sufficient to cure such cases In gouty people, lotions containing zinc sulphate sometimes increase the irritation, and if there is definite evidence of chronic gouty inflammation in mucous membranes elsewhere, e g, a gouty pharyngitis, it is better to use a mild alkaline lotion of biborate of soda If the inflammation persists, a single painting with 1 per cent silver nitrate will often work wonders, especially in gouty people More than 50 per cent of all cases of conjunctivitis occur in the form of chronic angular conjunctivitis (diplobacillary conjunctivitis)

Chronic Angular Conjunctivitis—This mostly occurs in adult life, and when it attacks children it is very apt to cause marginal blepharitis The disease usually commences in a subacute fashion, becomes chronic, and persists for many months if untreated As the symptoms are often mild, it may be many months before treatment is sought

The treatment to be adopted is a lotion containing one or two grains of zinc sulphate to the ounce, made up with a little cherry laurel water This smarts —in some cases it smarts very badly—and patients must be warned of it, but in no case must a little cocaine be prescribed with it just to take away the pain If prescribed the relief is immediate, but in a short time the congestion recurs, and, like drug addiction, the effect is shorter with each dose, and in a week or ten days a sodden condition of congestion arises much more difficult to treat than the original inflammation A similar condition of chronic congestion may result from the long-continued use of a lotion or drops containing adrenaline Argyrol is of service in some cases, but the mainstay is zinc sulphate For the comfort of the patient it is advisable to prescribe a simple ointment, to be used at night, to prevent the gumming of the lids

Trachoma (Granular Conjunctivitis, Egyptian Ophthalmia) (*Fig* 476) —In its typical form the granules, varying in size from a small hemp seed to a lentil, are scattered all over the tarsal surface of both lids Examination of the lids alone, in the majority of cases, suffices to differentiate trachoma from other forms of conjunctival disease In doubtful cases the determining factor is the presence of pannus, the invasion of the superficial layers of the cornea under lying the epithelium by connective tissue carrying blood-vessels To examine for the earliest stage of pannus a corneal loupe is necessary In a normal eye the conjunctiva overlaps the margin of the cornea as a greyish translucent band with a sharp, clear-cut edge The terminal twigs of the conjunctival vessels can be

seen reaching this edge, but never passing it In the earliest stages of pannus the edge loses its clean-cut appearance and becomes ragged, and here and there tiny vessels can be traced on to the cornea In well-marked pannus due to trachoma, the main course of the vessels is vertical, and mostly from the upper margin When the pannus is advancing, there is a greyish area in the cornea beyond the vascular region

The treatment of trachoma must be both drastic and persistent Here sulphonamide treatment has been known to give satisfactory results In a severe case where the trachoma bodies are well marked but not hard, they should be expressed by means of Grady's forceps or Knapp's roller forceps As this is a very painful process, and as it is essential that it should be done thoroughly, it is advisable to give a general anæsthetic, though some cases will tolerate it after thorough cocainization The operator puts on goggles, and then grasps the everted tarsal plate between the blades of the forceps and forcibly expresses the contents of the follicles A solution of perchloride of mercury in glycerin (1–100) is then brushed in with a hard tooth brush, the sacs are washed with boric acid lotion, and boric acid ointment is put between the lids Where the granules are harder, expression must be replaced by scarification The everted lid is supported on a horn spatula and scarified with a Beer's knife (*see Fig* 472) The first incisions should be made over the most prominent granules, and these may be scraped out with a small Meibomian curette The lids are then brushed with the strong perchloride solution and treated as before Usually much reaction follows this treatment, and iced compresses will be found useful till it subsides During this period the eyes should be bathed frequently with boric acid lotion, and ointment should be applied night and morning

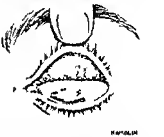


Fig 476 —Trachoma The upper *lid is everted to show follicles in the* tarsal conjunctiva. The vessels growing over the upper part of the cornea constitute pannus

The subsequent treatment of these cases is the same as for milder ones The affected surface is rubbed once daily with a stick of copper sulphate, and the patient uses a lotion of boric acid and zinc sulphate At the end of a month the applications can be reduced to three a week, and later to two or even one a week A marked improvement usually manifests itself in three or four weeks, but often after a time the case seems to come to a standstill The substitution of silver nitrate for the copper sulphate, either as a 2 per cent solution or in the solid form known as mitigated stick, will then be beneficial In fact this variation in the treatment from time to time is advisable in all cases, and it is also useful to allow periods of freedom from any treatment other than a simple astringent lotion Many other forms of treatment have been suggested and tried from time to time, such as X rays, radium, and carbon dioxide snow Most of them have had a considerable vogue for a short time, and then been again replaced by older methods

AFFECTIONS OF THE CORNEA

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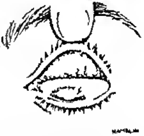

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injury has taken place, and an abrasion is suspected, a drop of fluorescein will stain the denuded area a bright green The eye is bathed, a drop of atropine is instilled, and a pad and bandage are applied Boracic bathing should be repeated every four hours As a rule, the pad can be taken off in twenty-four hours If the patient finds the pressure of a pad intolerable, dark glasses with side pieces can be substituted for it If the surface is not covered in that time, another drop of atropine should be put in and the pad or dark glasses replaced

Foreign bodies embedded in the cornea are mostly particles of steel or emery from the emery-wheel or grit from an engine Careful examination with a loupe is often required for their detection, as they are frequently very small and difficult to find A drop of fluorescein is of great assistance in doubtful cases, the staining area indicating the position of the foreign body Another useful indication is a slight but definite contraction of the pupil on the affected side due to reflex

Fig 477 —Corneal spud

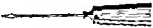

Fig 478 —Discission needle

irritation of the iris This is often accompanied by some ciliary flush, occupying that part of the limbus which is adjacent to the foreign body The removal must be done with as little injury to the corneal epithelium as possible Occasionally, after dropping in a little 4 per cent cocaine, the foreign body may be so loosened that it can be removed by means of a little cotton wool, soaked in boric acid, on the end of a glass rod If this does not suffice, a corneal spud should be used (*Fig* 477), and the removal must be complete The eye is well cocainized, and a strong light focused on it by an assistant The patient is told to look fixedly in whatever direction enables the operator to get the best view of the object to be removed If the spud fails to remove it, recourse may be had to a discission needle (*Fig* 478), but in digging out foreign bodies with this, care must be exercised not to injure the cornea more deeply than is necessary After removal, bathe carefully, put in a small piece of atropine ointment, and bandage the eye

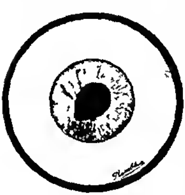

Fig 479 —Small perforating wound of the cornea *

Perforating wounds of the cornea are apt to have serious consequences, and the house surgeon should obtain the services of one who has had special training in ophthalmic surgery *Fig* 479 shows a small linear perforating wound of the cornea through which a globular portion of iris has prolapsed, bringing about a pear-shaped deformation of the pupil

In all cases of perforating wounds, whether simple or complicated, the house surgeon must be carefully on the outlook for keratic precipitates It is not the eye which passes into a condition of general suppuration which is most likely to set up sympathetic ophthalmia such an eye is removed, and with its removal usually all danger is past, but the eye which remains inflamed and irritable, and

in which there appear on the back of the cornea tiny round dots, is almost certain, *if left, to cause a sympathetic inflammation* in the other eye Such an eye ought to be excised at once

Corneal Ulcers —If not severe, ulcers will usually react favourably to very simple treatment The first essential is to secure rest for the eye For this purpose atropine drops (½ per cent) are put in, and the eye is covered with a pad lightly bandaged on Only in cases where the ulcer is complicated by conjunctivitis with a large amount of secretion is this latter abandoned The atropine paralyses the action of the iris and ciliary muscles, and so acts as a physiological splint, while the pad keeps the eyelids at rest over the cornea Frequently during the day the eye should be bathed with warm boric acid lotion It is advisable in all cases of corneal ulceration to inquire into the habits of the patient In children especially, attention should be given to the condition of the alimentary tract Small doses of compound rhubarb powder (10 to 15 gr) may be prescribed, to be taken three times a day In adults, a pill of calomel and colocynth at night, followed by a saline purge in the morning, is often of great service in initiating the treatment

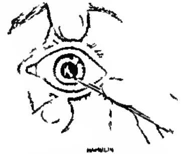

Fig 480 —*Application of pure carbolic to an ulcer of the cornea—for technique see text The application is being made with a camel hair brush*

When the ulcer is of a more severe nature it becomes necessary to adopt other local measures *Of these the most generally useful* is painting with pure carbolic acid (*Fig* 480) First put in two drops of cocaine, and then a drop of fluorescein (being careful to mop up any excess with a pad of absorbent wool) After a few seconds wash out the fluorescein with cocaine, and the ulcer will be found stained bright green With two fingers of the left hand hold the lids gently apart, dry the surface of the ulcer with a small piece of sterilized blotting paper, and touch the whole stained surface *with a small camel-hair brush* soaked in pure carbolic acid Dry off any excess of this with blotting paper and wash out the eye with saline or boric lotion before allowing the lids to close The end of a wooden match carefully pointed and soaked in carbolic is an excellent substitute for the brush If the ulcer is of the advancing type, most attention should be devoted to the advancing edge The cautery can be used with equally good results The benefit of using pure carbolic is that it is itself an anæsthetic In using the cautery, a dull-red heat is required, and the touching should be done very lightly After cauterizing or touching with phenol, continuous boric acid fomentations, with free hot bathings at each change, and atropine drops twice a day, should be ordered

Pus forming in the *anterior chamber* (hypopyon) is not in these cases a sign of serious inflammatory involvement of the iris and ciliary body The pus is usually sterile It is probably most frequently seen in pneumococcal ulceration It may form very rapidly, and with a healing ulcer it will become absorbed as rapidly as it forms If it is necessary to perform paracentesis, the hypopyon should be washed out with normal saline

When an ulcer is deep and there is a likelihood of perforation, no treatment is so valuable as paracentesis If an ulcer is allowed to perforate spontaneously,

injury has taken place, and an abrasion is suspected, a drop of fluorescein will stain the denuded area a bright green The eye is bathed, a drop of atropine is instilled, and a pad and bandage are applied Boracic bathing should be repeated every four hours As a rule, the pad can be taken off in twenty-four hours If the patient finds the pressure of a pad intolerable, dark glasses with side pieces can be substituted for it If the surface is not covered in that time, another drop of atropine should be put in and the pad or dark glasses replaced

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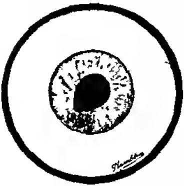

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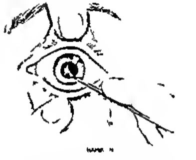

Fig 480 —Application of pure carbolic to an ulcer of the cornea—for technique *see* text The application is being made with a camel hair brush

When the ulcer is of a more severe nature it becomes necessary to adopt other local measures Of these the most generally useful is painting with pure carbolic acid (*Fig* 480) First put in two drops of cocaine, and then a drop of fluorescein (being careful to mop up any excess with a pad of absorbent wool) After a few seconds wash out the fluorescein with cocaine, and the ulcer will be found stained bright green With two fingers of the left hand hold the lids gently apart, dry the surface of the ulcer with a small piece of sterilized blotting paper, and touch the whole stained surface with a small camel hair brush soaked in pure carbolic acid Dry off any excess of this with blotting paper and wash out the eye with saline or boric lotion before allowing the lids to close The end of a wooden match carefully pointed and soaked in carbolic is an excellent substitute for the brush If the ulcer is of the advancing type, most attention should be devoted to the advancing edge The cautery can be used with equally good results The benefit of using pure carbolic is that it is itself an anæsthetic In using the cautery, a dull red heat is required, and the touching should be done very lightly After cauterizing or touching with phenol, continuous boric acid fomentations, with free hot bathings at each change, and atropine drops twice a day, should be ordered

Pus forming in the anterior chamber (hypopyon) is not in these cases a sign of serious inflammatory involvement of the iris and ciliary body The pus is usually sterile It is probably most frequently seen in pneumococcal ulceration It may form very rapidly, and with a healing ulcer it will become absorbed as rapidly as it forms If it is necessary to perform paracentesis, the hypopyon should be washed out with normal saline

When an ulcer is deep and there is a likelihood of perforation, no treatment is so valuable as paracentesis If an ulcer is allowed to perforate spontaneously,

be left in this position The treatment of a lachrymal abscess which does not show signs of pointing consists of slitting up the lower canaliculus freely, so as to provide a better means of escape for pus from the sac, and then free fomentation If the abscess shows signs of coming to a head, it should be opened and evacuated freely, the sac gently scraped and the cavity plugged with gauze and then fomented It is most inadvisable to attempt to probe during an attack of dacryocystitis It may set up a most severe orbital cellulitis, followed by retrobulbar neuritis and consequent blindness

SQUINT

Operations for squint are highly specialized and should not be undertaken except by those who have had training and experience in them Minor degrees of squint can in some cases be overcome by special exercises with a modified form of stereoscope combined with the use of suitable glasses and various other measures

CATARACT

Treatment of a Cataract Patient—When possible a patient who is going to have a cataract extraction should be admitted to the hospital two days before the operation On the evening of admission a culture and a smear should be taken from the conjunctiva of the lower lid of the eye to be operated on The culture should be incubated for forty-eight hours The presence of a few colonies of *B xerosis* or of *Staphylococcus albus* is considered of no pathological importance, but if any other organisms are present, operation must be delayed until local treatment with lotion and drops has rid the conjunctiva of their presence Of course, any grosser inflammation of the conjunctiva or obstruction of the tear duct must be treated and cured before the operation can be performed Meantime, the urine should be examined (especially for sugar) The evening before operation a mild laxative should be given, drastic purging is quite unnecessary, and may be disadvantageous even, since in some people it leads to constipation in the following days, and that is one of the dangers to be avoided after cataract extraction The patient should have a light digestible breakfast on the morning of the operation Twenty minutes before the time fixed for operation, some 5 per cent cocaine in 1-2000 adrenaline should be dropped into the eye, this is repeated in ten minutes, and again just before the patient goes to the theatre, the eye being kept covered between the instillations The patient usually walks to the theatre

The eyelashes should be cut short, and the skin of the eyebrows and eyelids sterilized with iodine solution

The instruments which should be put out for cataract extraction with iridectomy are a speculum, two pairs of fixation forceps (one broad and one narrow), Graefe's cataract knife (the point of this should be tested on the drum and should go through the kid without the least resistance), iris forceps and iris scissors (de Wecker's), curette and cystotome, and repositor It is also advisable to have in readiness either a lens scoop (Critchett's) or a vectis, and an irrigating apparatus for washing matter from the anterior chamber This consists of a suitable cannula rubber tubing to an undine containing sterile saline at 102° F

c capsule forceps to tear off a portion of the anterior itting it with the cystotome The instruments (*see* special porcelain tray, and the sterilizer should be

large enough to take the tray with all the instruments It is advisable to sterilize the Graefe knife separately, lest anything should happen to the delicate point from carelessness in putting it into the tray and taking it out

Fig 485.—Graefe's cataract knife

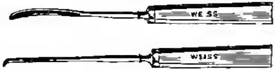

Fig 486 —Moorfields curette and cystotome

Fig 487 —Critchett's cataract spoons

Fig 488 —Taylor's vectis

Fig 489 —Couper's capsule forceps

After-treatment of Cataract Extraction—After the operation the patient must be carried back to bed with as little disturbance as possible To facilitate this it is desirable to have under the patient a strong canvas sheet, with places at each side through which poles can be slipped, to lift him from the operating table to the trolley and from the trolley to the bed where he can lie on his back, propped up with pillows or on a special canvas sling For the first six hours after operation the patient should lie as quiet as possible, but after this period strict immobility need not be insisted upon and he should be instructed to relax all his muscles as far as possible At night the sleeves of the night dress should be pinned down to the breast, to prevent the patient rubbing the eye during sleep or on waking in the morning In the absence of pain, the first dressing is usually performed after the lapse of forty eight hours, when the eyes are uncovered and the eyelids gently bathed until they can open A drop of atropine is instilled, but no attempt should be made to see the wound This bathing should be repeated on the third day, and only then should the wound be examined After the fifth day, only the eye operated on is covered and the patient is allowed to sit up in bed During the first three days the food should be soft There is no need for it all to be fluid, but nothing should be given which requires mastication If the bowels do not act naturally, no aperient should be given until

after the third day The patient must be warned not to sneeze Any tendency to do so can be checked by pressing firmly on the middle of the upper lip On the seventh day the patient is allowed out of bed to sit on a chair, and on the tenth day the bandages are given up and dark protective glasses are put on During this period the atropine drops are put in once a day, but if the eye is quiet on the tenth day this may be stopped The patient may leave the hospital as soon as the dark glasses are fitted He should continue wearing these until the proper correcting glasses are ordered It has become the practice of some surgeons now to leave the eye uncovered by pads from the first, simply using a protective shield There is much to be said in favour of the practice, as the mere covering in of a perfectly healthy, untouched eye may cause a certain amount of discharge to develop It is now almost a universal practice to block the facial nerve by novocain injection If this has been done, a stitch is inserted into the skin of the upper lid, and at the end of the operation it is secured to the cheek by a small piece of strapping, thus keeping the lid closed

ACUTE GLAUCOMA

It is very desirable for the house surgeon to know the main points in the diagnosis between acute glaucoma and acute iritis It is necessary to realize that the intra-ocular tension may be as high in the one as in the other, so that point by itself is of little value In acute iritis the pupil is usually small and the iris sluggish in reaction, in acute glaucoma the pupil is dilated, often oval with the long axis vertical or nearly so, and the iris is fixed In iritis the iris looks congested and muddy, in glaucoma it looks flattened and atrophic. In iritis the anterior chamber of the eye may look deeper than normal, in glaucoma it is shallow and may be absent towards the periphery of the cornea In glaucoma the circumcorneal congestion is apt to be coarser in character than in iritis Even when the diagnosis remains doubtful, there are certain lines of treatment which may safely be adopted pending the arrival of the surgeon. The most important of these is to attempt to relieve congestion both by local and general means Give a free purge (pil calomel c colocynth gr v, followed by haust alba ℥ij), and apply three of four leeches to the temple outside the bony margin of the orbit. If the diagnosis of glaucoma is certain, drop a ½ per cent solution of eserine into both eyes at once, and repeat every hour in the affected eye, but if there is any uncertainty it is best to await the arrival of the visiting surgeon before using either eserine or atropine in any form It is advisable to have the patient prepared for a general anæsthetic

OPHTHALMOSCOPY

With the advent and recent perfection of the electric ophthalmoscope, a means has been provided for ready examination of the fundus oculi Although interpretation of the findings requires considerable experience, it has been thought advisable to illustrate some of the more important surgical conditions which may be disclosed by the use of this instrument These are depicted in *Figs* 490–494.

Fig 490 shows a normal fundus except for the greyish-white area underlying the upper temporal vessels This is caused by the presence of a very early glioma of the retina (vel retinoblastoma), a highly malignant growth occurring in children at the age of about two years It is not usually diagnosed until a more advanced stage, when it has filled the vitreous chamber and forms a white mass visible in the pupil

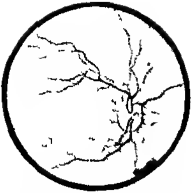

Fig 490 — Early glioma of the retina (vel retinoblastoma) (*Reproduced by kind permission of Mr Foster Moore*)

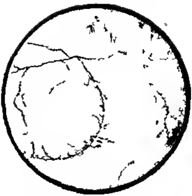

Fig 491 — Sarcoma of the choroid. (*By kind permission of Mr Nutt*)

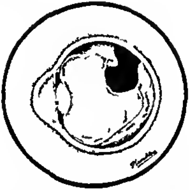

Fig 492 — Vertical section of an eye containing a melanotic sarcoma of the choroid. (*By kind permission of Mr Gimblett*)

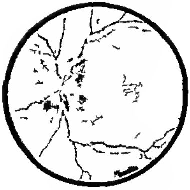

Fig 493 — An advanced stage of papillœdema

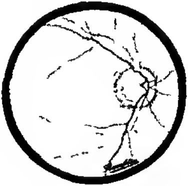

Fig 494 — Optic atrophy

Fig 491 shows the appearances produced by a sarcoma of the choroid in the upper outer quadrant of the fundus The retina is pushed forwards by the underlying growth, some of the vessels of which are visible The retinal vessels appear darker over the affected area because of the lack of red reflex behind them

Fig 492 explains the appearances seen in *Fig* 491 It is a vertical section of an eye containing a melanotic sarcoma of the choroid Ophthalmoscopically the appearances would be similar to those in *Fig* 491, except that the whole retina is detached, the portion not overlying the growth being separated from the back of the eye by an accumulation of fluid This is a common complication in choroidal sarcoma and makes ophthalmoscopic diagnosis from a simple detachment of the retina more difficult The small brown area in the upper part of the iris represents a second melanotic growth

Fig 493 represents an advanced stage of papillœdema, i e, œdema of the optic disc (or papilla) brought about by an increase in cerebrospinal fluid pressure

Compare with the disc in *Fig* 490, and note (1) Blurring of edges, (2) Striate hæmorrhages, (3) Turgescence of veins, (4) Partial hiding of arteries, (5) Wrinkles in retina on temporal side of disc, concentric with its margin, (6) Presence of a fan figure at the macula This is not often seen, and its presence usually indicates that the rise in cerebrospinal fluid pressure has been rapid, e g, in a subtentorial tumour

Fig 494 shows the appearances in one of the forms of optic atrophy The disc is greyish white in colour and shows the stippling of the lamina cribrosa The edges of the disc are clear and the calibre of the vessels unaffected Such a condition is seen in tabes and in diseases (e g, pituitary tumour) where optic atrophy is due to pressure on the nerve behind the point where the vessels leave it In optic atrophy due to other causes (e g, consequent on papillœdema), the vessels are usually reduced in calibre

CHAPTER LXII

THE TEETH

By George G Exner

It is of paramount importance to be able to visualize the structure of a tooth and the tissues surrounding it (*Fig* 495)

Pulp is the so called ' nerve ' of the tooth Decay, trauma, or irritation may cause inflammation of the pulp, and produce a pulpitis

Pulpitis.—The pain is throbbing and intermittent Thermal changes cause pain except in the early stages *Tapping the tooth causes no pain*, but pressure on a piece of cotton-wool inserted in the cavity gives pain Sedative dressings of carbolized resin, eugenol, or oil of cloves alleviate the pain, and should be inserted on a pledget of cotton wool into the cavity as a temporary dressing *If no relief ensues, remove the pulp* If left untreated pulpitis causes disintegration of the pulp, with a resulting peri-apical abscess (*Fig* 496)

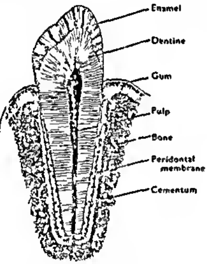

Fig 495 —A cross-section of a tooth

Fig 496 —Peri-apical abscess showing filled root canals

Periodontal membrane is a thin fibrous membrane and corresponds to the periosteum of bone Its fibres are so formed as to sling the tooth into its bony surroundings

Periodontitis.—The pain is dull and constant Thermal changes do not usually cause pain *Pressure or tapping of the tooth causes pain* If the condition is due to trauma, the treatment is extraction of the tooth If periodontitis is due to degeneration of pulp, the latter should be opened and drainage through the tooth established *If no relief ensues, extract the tooth*

Odontalgia or Neuralgia.—This may be local or referred. If the condition is dental in origin, it is associated with a tooth on the same side Referred

neuralgia never crosses the midline The offending tooth should be treated or removed

Chronic Suppurative Periodontitis (Pyorrhœa Alveolaris)—In the peri odontal membrane a chronically inflamed condition may arise independently of sepsis derived from a dead pulp *If treatment is undertaken early it usually cures* or checks the progress of the disease, but chronic cases of long standing are very intractable

Thorough scaling of the teeth, especially the removal of the tartar below the gum margins, and massage of the gums either by means of the fingers or with wooden tooth picks to get between the teeth go a long way to enforce shrinkage of the gums and their return to normality These measures eliminate or decrease the pocket formation and flabbiness of the gums around the teeth If after a fair trial has been given the gums have not shrunk to normality, then gingivectomy may be undertaken This is a minor operation, and consists of the surgical removal of the excess gum, thereby eliminating the pockets of gum around the teeth and establishing drainage The healed tissues are left normal

The chief difficulty of treatment, however, exists in diagnosing the pyorrhœa correctly *It is of the utmost importance that systemic disease be excluded before the local treatment of pyorrhœa is undertaken*

Acute Alveolar Abscess—In order to prevent serious conditions and symptoms supervening, and to avoid the pointing of the abscess outside the mouth, the first essential is to evacuate the pus *This may be done in two ways*—namely, by removing the tooth or by incising the abscess It is best to incise the abscess, as in some cases the dentist will be able to save the tooth If no pus or palpable swelling can be demonstrated, removal of the tooth is indicated The incision should be into the mouth if possible The best place for the incision is that shown in *Fig* 497

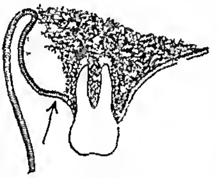

Fig 497—Subperiosteal abscess Arrow indicates point of incision

The incision is made under a short general anæsthetic or the site is frozen with ethyl chloride If much pus is present, a wick of gauze is put in as a drain and removed within twenty four hours *Actually, by opening the abscess the acute condition is converted into* a chronic one, and after a few days the dentist is able to treat the tooth, which if single rooted can probably be restored to a healthy condition

Neglect of an acute alveolar abscess may lead to osteomyelitis

EXTRACTION

Local Anæsthesia for Tooth Extraction—If possible a syringe designed for the purpose should be used, as it gives greater control than the ordinary type of Record syringe

Sterilization of the mucous membrane of the mouth is difficult After the patient has thoroughly rinsed out the mouth with an antiseptic solution, the area about to be injected should be painted with tincture of iodine A 2 per cent solution of novocain is injected into the sulcus around the tooth It is best to push the needle deep enough to strike the bone and then gently to retract before delivering the solution This avoids the possibility of injecting beneath the periosteum and stripping the latter from the bone, with subsequent after pain A quantity of fluid—about 1 c c—is deposited and the same procedure repeated on the palatal side in the upper jaw or the lingual side in the lower jaw The liquid is allowed to seep in for about ten minutes, by which time complete anæsthesia will have ensued

Principles.—It is of the utmost importance for the house surgeon to realize that *pulling or the application of violent force or indiscriminate wrenching* is likely to have no other result than fracture of the tooth, and possible serious injury to the jaw

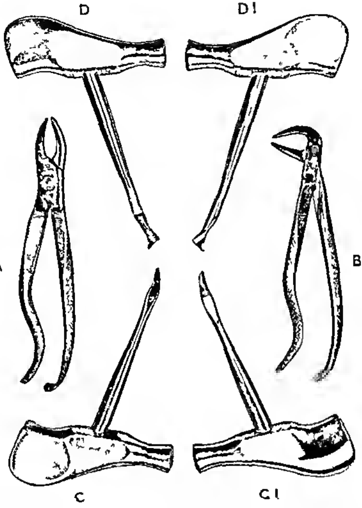

Fig 498 —A Universal upper forceps, showing thumb rest B Lower hawksbill forceps showing thumb rest C and C1 Right and left straight elevators, D and D1, Right and left curved elevators

The patient should be sitting in a firm, strong chair, with the neck and head well supported, and the head leaning slightly backwards The operator is always on the patient's right side, sometimes in front and sometimes behind, according to the tooth to be extracted

The removal of teeth is usually undertaken with forceps, of which various types exist For ordinary uncomplicated extractions only two are necessary, an upper universal type (*Fig* 498, A) and a lower hawksbill (*Fig* 498, B) The modern forceps all have a thumb rest to give greater control and power during extraction Levers are sometimes employed for removing lower molars and roots (*Fig* 498, C, D)

Application of Forceps—The operator always stands on the right hand side of the patient

The crown, or whatever part of the tooth is left above or level with the gum margin, is used as a guide for the blades of the forceps One blade is first applied either lingually or buccally against the crown, the opposite blade of the forceps usually following into its correct position Gentle pressure pushes the blades between gum and tooth until they have been forced well up in the upper jaw or down in the lower jaw, as the case may be Closure of the forceps grips the base of the tooth Pressure is now applied with the closed forceps in the direction of the tooth root so as to force the tip of the root, or roots, to become the fulcrum of the leverage If this is borne in mind throughout the process of extraction, the danger of fracture of a tooth is reduced to a minimum A gentle lateral movement loosens the tooth, the final removal of the tooth being in an outward direction This lateral movement applies to the extraction of all teeth except the upper incisors and lower premolars, which have more or less conically shaped roots In the case of the latter a continuous slight rotary movement simplifies their extraction In the multiple rooted teeth the forceps should always be applied over the anterior roots, as these are usually the stronger and fracture of the tooth is less likely to ensue

Extraction of the Individual Teeth—

Upper Incisors and Canines—The blades are applied and driven upwards, and the tooth is firmly grasped and then gently tilted inwards and outwards and slightly rotated at the same time The forefinger and thumb of the left hand guide the forceps into position, support the alveolus during the extraction, and hold the lip out of the way (*Figs* 499, 500)

Fig 499—Showing use of left hand when operating on left side of upper jaw

Fig 500—Showing use of left hand when operating on right side of upper jaw

Upper Premolars—The first premolar usually has bifurcated roots, and is, perhaps, the most difficult of all the teeth to extract, and the most liable to break. No rotary movement should be undertaken

Upper Molars—Apply the forceps and lever outwards The tooth should not be pulled, but rather pushed firmly into its socket and levered sideways

Lower Incisors, Canines, and Premolars—In all lower extractions the left hand supports the jaw On the left side the forefinger holds away the lip, the second finger the tongue, and the thumb gives a supporting grip to the whole jaw On the right side the forefinger holds away the lip, the thumb holds the tongue, and the middle finger supports the jaw (*Figs* 501, 502)

After application of the forceps, the incisors are removed by tilting inwards and outwards, as they have flattened roots The canines and premolars have conical roots, and rotation combined with tilting may be employed

Fig 501—Showing use of left hand when operating on left side of lower jaw

Fig 502—Showing use of left hand when operating on right side of lower jaw and standing behind the patient

Lower Molars—For the right lower molars the operator stands behind and to the right of the patient The jaw is supported by the left hand (*see Fig* 502) The lower molars have two roots Application and grip of the forceps should be made over either one or other of these roots, preferably over the anterior root, but never between them The tooth is tilted inwards and outwards until well loosened before its ultimate delivery is undertaken

The Use of Elevators—These are chiefly employed in the removal of lower molars and roots Their application is seldom indicated in the upper jaw The straight elevator, of which there are two—namely, a left and a right—is inserted between the molar teeth The flat surface of the blade lies against the tooth which is to be extracted The point of the blade is forced downwards into the alveolus, and the lever bent backwards so that its point engages with the root, the tooth in front being used as a fulcrum It is an especially useful and easy method for the removal of the third lower molar

The curved elevators are chiefly used for removing fractured roots of lower molars If a fractured portion of one root remains, the curved elevator is passed into the empty socket, and, with a rotary movement, its point is forced through the septum, which it breaks away, engages the root and elevates it from its socket (*Fig* 503)

Fig 503—The use of a curved elevator for removal of a root in the lower jaw

After-treatment.—In all cases where teeth have been removed a mouth-wash should be prescribed and used frequently In some cases it may be advisable to syringe an antiseptic lotion into the socket or sockets A useful mouth-wash is —

℞ Liq Potassæ	℥i	Tinct Cocci	q s
Acid Carbol Liq	℥ss	Aquam	ad ℥i

Misce Sig *Not to be taken* Use one teaspoonful in half a tumbler of warm water as a mouth wash

Or, of a milder character —

℞ Acidi Borici	gr x	Aquam	ad ℥i
Zinci Sulph	gr iij		

Misce

Hæmorrhage after Extraction —Hæmorrhage may be primary, reactionary, or secondary

Primary and Reactionary Hæmorrhage —The treatment is the same for both forms Hot mouth-washes are usually of no avail Plugging the socket with gauze soaked in adrenaline 1–1000 solution may be tried Gauze dipped in oil of turpentine and plugged into the socket is a good hæmostatic The most modern method is the local application of snake venom from the Russell viper This is obtainable under the proprietary name of Stypven Gauze saturated with the solution is plugged into the socket and repeated in twenty to thirty minutes In the ease of hæmophiliacs, its local application is always indicated. Blood transfusion should be insisted upon if the bleeding is not under control within an hour or two

Secondary Hæmorrhage —This is rare The socket should be cleaned of its septic clots, syringed with some mild antiseptic, and then the same treatment undertaken as for primary hæmorrhage

Pain Continuing after Extraction.—Hot mouth-washes will give relief Pain continuing for long after extraction is generally due to inflammation. The socket should be cleaned out and kept frequently syringed with a dilute antiseptic If very painful it should be swabbed with 5 per cent cocaine solution and then thoroughly cleaned Any loose fragments of bone are removed The socket is lightly plugged with 5 or 10 per cent iodoform gauze which has been saturated with Dentalone, or the socket dusted with anæsthesin or orthoform powder, which provides a mild anæsthesia lasting about twenty-four hours

Complications of Extractions not considered already —

Fracture of the Tooth —This is generally due to the blades of the forceps not penetrating deeply enough, or not being closed firmly, one blade thus being allowed to slip slightly, or to the forceps not being kept firmly pressed down until the tooth is loosened from its socket, or to hurry in manipulation It is sometimes impossible to prevent the apex of a root with thickened cementum from breaking off

Extraction of the Wrong, or an Adjacent, Tooth —The tooth should be washed in sterile saline solution and replaced in its socket, the mandible is then fixed with a four-tailed bandage The patient should be advised to consult a dentist with a view to further treatment

Fracture of Bone —Small fractured portions of alveolus are of little consequence and should be removed More extensive fractures must be treated with appropriate splints

Trismus —A general anæsthetic is administered and the mouth carefully opened with a Mason's gag

Laceration of the Gum —Torn portions of gum usually reunite if pressed into place An extensive tear may require a suture A fragment only adhering by a thin pedicle should be removed with scissors

CHAPTER LXIII

THE SKIN

By J E M Wigley

To become proficient in examining the skin will repay the practitioner and the hospital resident

In order to pursue the study to the best advantage, some inexpensive armamentarium is desirable

ARMAMENTARIUM

A Good Light is essential It should come from behind the examiner If daylight is not available, an excellent substitute is the light blue coloured electric bulb, *preferably with a dull white metal reflector For the purpose of* showing up colours this light emulates daylight

Magnifying Spectacles (*Fig* 504) are better than a magnifying glass Each lens is + 5D, combined with 10D prisms, having the base inwards The spectacles can be made by a competent optician In addition to providing binocular magnification, these spectacles leave both hands free for any operative procedure which may be required

Fig 504—Magnifying spectacles

Fig 505—Whitfield's epilation forceps

A Glass Spatula or a Microscope Slide is useful for exerting pressure upon the skin For instance, in erythematous lesions the colour disappears entirely under pressure, while in purpura or granulomatous infiltrations, e g, lupus vulgaris, some of the colour remains

Whitfield's Epilation Forceps (*Fig* 505) are useful for removing hair or pediculi

EXAMINING AN ERUPTION

It is essential that the whole of the eruption should be seen, the patient being *completely undressed if necessary*

The Predominating Elementary Cutaneous Lesions should be noted These lesions are divided into two classes —

a Primary lesions —	*b Secondary* lesions —
Macules	Scales or squames
Papules	Crusts and scabs
Nodules	Excoriations
Tumours	Fissures
Vesicles	Ulcers
Bullæ (or blisters)	Scars
Pustules	Stains or pigmentation
Wheals	

Distribution is important Scabies has a distribution just as typical as herpes zoster The position of the eruption is of great help in determining whether it is of 'occupational' origin or not

Colour of an eruption is often characteristic The bright red background of acute eczema or dermatitis, the pink background of psoriasis, the brownish colour of most syphilides, and the lilac tint of lichen planus are excellent examples of this

Symptoms are less reliable It is as uncommon for eczema not to itch as it is for psoriasis or syphilides to itch, yet cases occur in which the symptoms are unusual The presence or absence of 'scratch marks' should be noticed particularly, as a check on the symptoms

History of an eruption is important, especially regarding previous rashes Within reason, it is wise to listen to the patient's ideas about the origin of a rash This is especially the case if there is any question of it being a 'contact' dermatitis (i e , dermatitis due to an external irritant) If the patient believes that a fur or cosmetic preparation or a plant, has caused the rash she is likely to be correct

CONFIRMATORY DIAGNOSTIC MEASURES

Microscopical Examination —The microscope is essential for confirming the diagnosis of two common conditions viz scabies and ringworm of the scalp No staining is necessary The material is simply mounted on the slide with a few drops of liquor potassæ B.P C. The diaphragm of the microscope should be partly closed for too much light makes the examination more difficult The 2/3 or the 1/6 objective gives all the magnification necessary

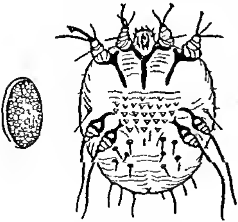

Fig 506 —Female *Sarcoptes scabiei* with ovum

Scabies —It is best to shave off the superficial layers of the suspected 'burrow' with a sharp scalpel and to mount the material in liquor potassæ Using the 2/3 objective the acarus or some of her ova will readily be seen (*Fig* 506)

Ringworm (*Tinea of the Scalp*) —A few broken hairs, called 'stumps', should be pulled out with Whitfield's forceps and mounted in the liquor potassæ With the 2/3 objective the irregularly broken ends of the 'stump' can be seen, and it is evident that the normal

structure of the hair is obliterated (*Fig* 507) With the 1/6 objective the spores can be made out as a 'mosaic' pattern wrapped round, and replacing, the hair structure (*Fig* 508)

Pediculosis Capitis —Using the same technique as for tinea, 'nits' attached to the hairs can be demonstrated By employing the microscope the diagnosis can be settled in a way which will convince any sceptical parent

The Patch Test (syn 'Eczema Test') —This is used in the search for the responsible external irritant in cases of suspected 'contact dermatitis' It is carried out as follows The test substance is placed in contact with intact non-hairy skin, covered with gutta percha or similar waterproof material, and held in

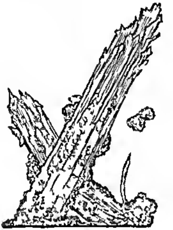

Fig 507 —Stumps of hair infected with ringworm (2/3 objective)

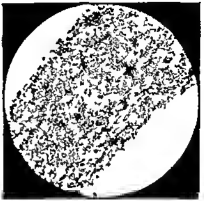

Fig 508 —Small spored ringworm of scalp (Jacobi) (1/6 objective)

place by strapping A 'control' piece of gutta-percha and strapping is, of course, necessary The substance is left in contact for varying periods up to 72 hours, and only those cases are said to be 'positive' in which the reaction is in the form of eczema, i e, besides redness and swelling, papules and vesicles occur

Patch tests need careful interpretation A positive test has been reported after a delay of 24 days, and I have seen one after a delay of 5 days A positive reaction is not conclusive proof that the substance has caused the dermatitis the positive reaction may be due to the test substance being too strong, or to polyvalent sensitivity Conversely, a negative reaction does not prove conclusively that the substance can be exonerated, for the test never quite fully reproduces the natural conditions of exposure The test should not be carried out when the dermatitis is in the acute stage, and the result should be regarded as only one link in the chain of evidence leading to the diagnosis

SKIN TESTS FOR TUBERCULOSIS

1 *Pirquet Test* —A couple of drops of old tuberculin is placed on the skin and then vaccinated in by superficial scarification Red papules or vesicles at the site within 48 hours indicate a positive reaction

2 *Mantoux Test* —0 1 c c old tuberculin in normal saline is injected intradermally Dilutions of 1–1,000,000 to 1–10,000 are used A positive reaction, shown by hyperæmia and infiltration, appears in 6–8 hours, is at its maximum in 24–48 hours, and subsides in 6–10 days In assessing the value of the test the dilution of the old tuberculin used is of great importance

In both tests a 'control' with normal saline is essential

SOME DERMATOLOGICAL OPERATIONS

Carbon-dioxide Snow.—This is a valuable method of treating such conditions as nævi, moles, warts, and small rodent ulcers The snow is made by allowing liquid CO_2 to evaporate quickly Liquid CO_2 is contained in a cylinder having a nozzle with a fine bore A piece of baize or chamois leather is folded into the shape of a bag, and held tightly over the nozzle with the gloved hand When the valve is opened by means of the key, the vapour rushes out and solidifies in the bag The snow is scraped off and placed in the applicator Applicators are made of vulcanite and resemble aural specula They are of different sizes and each is fitted with a plunger rod so that the snow can be pressed firmly down to form a solid pencil The applicator with the solid snow is then transferred to the

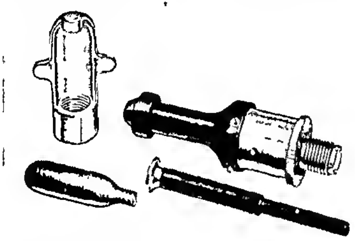

Fig 509—Apparatus for making CO_2-snow pencils (Sparklets Ltd)

lesion and the amount of pressure varied by pressing on the plunger rod with the free hand The amount of pressure has a great effect on the reaction produced

Small "Sparklets" of CO_2 snow, complete with an applicator (*Fig* 509), are a convenient and economical way of using the snow

With the solid CO_2 snow the effect is determined by the length of exposure and the degree of pressure The length of exposure ranges from about five seconds to two minutes or more, but it is difficult to lay down hard and fast rules After five to ten seconds with firm pressure, the underlying skin is frozen into a solid white disc This thaws in about a minute, and is followed in a couple of hours by an inflammatory reaction and occasionally by a blister Healing occurs in about a week In treating nævi one seldom employs an exposure longer than thirty seconds Exposures of one minute or more cause destruction of the soft parts and are usually followed by scarring, this is the aim when treating rodent ulcers In the treatment of warts the thick horny surface necessitates comparatively long exposure, and less than one minute is seldom successful

The firmer the pressure the more marked will be the destructive action of the snow The actual application is not very painful, but thawing can be really painful, as anyone who has suffered from frost-bite can testify

When lesions are of irregular shape, or of considerable size, it may be more effective to dissolve the snow in acetone or ether and paint the resulting mixture on with a brush The mixture should be of the consistency of melting snow or 'slush' It must be painted on fairly quickly The application is painful and usually it causes a superficial blister This method of treatment is useful for certain conditions, particularly 'port wine stains'

Cauterization—An electro-cautery is efficient when the lesion is small, otherwise a Paquelin cautery is advised Cautery points should be short, for a short point is more easily controlled The cautery point should be at a dull red heat and care taken not to press it in deeply, or a scar will result It is better to repeat treatment at weekly intervals than to cause scarring No anæsthetic is necessary The application causes less pain than would be anticipated

Lesions which are amenable to cauterization are as follows —

Warts, particularly multiple warts on the scalp, beard area, or those which are so often seen at mucocutaneous junctions

Spider Nævi—A fine pointed cautery at dull red heat is inserted into the centre of the nævus for about one second

Granuloma Pyogenicum (syn Botryomycosis Hominis)—This can be treated particularly successfully with a cautery The lesions, which are usually solitary, cherry-red in colour, and elastic in consistence, vary in size from a pea to a walnut A local or general anæsthetic is necessary and the Paquelin cautery is preferable When the cautery is first applied there will be bleeding, cauterization should be continued until bleeding has ceased A dry dressing is applied When the scab separates, the area will be found to have healed without scarring

Sharp Volkmann's Spoon—The particular indication for the use of this instrument is *plantar warts* These painful lesions are single or multiple, and are frequently thought to be corns They have an appearance of a wart let into the epidermis of the sole of the foot or toes They are surrounded by a ring of hard epidermal tissue, and are tender on pressure Plantar warts should never be 'excised' A general anæsthetic is necessary The spoon should be inserted between the wart and the hard ring of epidermal tissue Considerable force is necessary to shell out the wart The size of the ensuing cavity is often surprisingly large and there is often bleeding The cavity is packed with iodine gauze or trichloracetic acid The dressing is removed in twenty-four hours and does not need repeating

Thereafter simple cleanliness is all that is required

BOILS

A boil is a pus-coccal infection of a pilosebaceous follicle It begins as a small itching reddish nodule This becomes hard and painful as it enlarges, and culminates in a central necrosis with the separation of a 'core'

Boils should not be incised until there is definite softening in the centre, and then only to relieve pain Hot linseed or similar poultices are the best method of spreading the infection to more follicles and should be avoided Magnesium sulphate paste should be used with care, as it is very irritating to a number of skins

Paintings around the lesion with surgical spirit is helpful, and an elastic adhesive plaster or a mercurial plaster applied to the boil is very effective This will need to be changed daily The cautious use of ultra violet light is good

CHAPTER LXIV

THE TREATMENT OF GONORRHŒA

By A E W. McLachlan

The treatment of gonorrhœa has been greatly modified by the introduction of the sulphonamide group of drugs local treatment, although indicated in many cases to complete the eradication of infection, is now relegated to a place of secondary importance, and in the opinion of many authorities should be commenced only when indicated by relapse or refractoriness to drug therapy Others maintain that the best results follow combined local and oral therapy and that the risks of relapse or of residual foci of infection are minimized

General Treatment —Rest in bed, if possible, is advisable , if this is impracticable, exercise should be curtailed to the minimum during the acute stages of infection Diet should be non-stimulating, and should include the minimum of meat and fried and re-cooked dishes Pickles, spices, condiments, and all forms of alcohol must be avoided Regulation of the bowels should be accomplished with mild purgatives A hot sitz bath lasting 20 minutes once or twice daily is of value Increased fluid intake—water, weak tea, mineral waters—promotes flushing of the urethra

Of value in this respect, and in relieving any dysuria, are the alkaline diuretics, e g , potassium citrate 30 gr q d s , or the following prescription —

℞ Pot Cit.	gr xx	Tinct Hyoscyam.		ʒss
Pot. Bicarb	gr xxx	Infus Buchu	ad	℥ss

q d s

Tinct bellad 5 min may be added if there is local spasm

IN THE MALE

Determination of Anatomical Extent of Infection.—Before commencing treatment the anatomical extent of involvement is determined by the two-glass test. The patient is instructed to pass 3–4 oz of urine into a conical urine glass, and a like amount into a second The contents of the first indicate the severity of infection of the anterior urethra, and the second whether the posterior urethra is involved The presumptions from the tests are —

1st Glass	*2nd Glass*	*Presumption*
Haze (+ threads)	Clear	Anterior urethritis
Haze (+ threads)	Haze	Anterior and posterior urethritis

A more accurate method of carrying out this test is by washing out the anterior urethra with cold clear lotion until the washings come back clear Haze in the urine subsequently passed indicates a posterior urethritis , further glasses may be used to determine the state of the bladder urine, and in non-acute cases to collect prostato-vesicular secretions after prostatic massage

Local Treatment :—

Acute Stage—Irrigation is the mainstay of local treatment of acute gonorrhœa, and is best carried out by the gravity method, with a douche can, rubber tubing, and Janet nozzle The hand syringe is a poor (and often septic) substitute

The lotions most serviceable in the acute stages are potassium permanganate 1–10,000 to 1–8000, albargin 1–8000, and zinc permanganate 1–8000 to 1–6000, at a temperature of 102°–104° F

The meatus is cleansed with soap and water and the tip of the Janet nozzle inserted into the urethra sufficiently firmly to occlude it The pressure of irrigating fluid may be regulated by the height of the reservoir and by partial occlusion of the rubber tubing by the finger and thumb, the nozzle being held and directed by the remaining three fingers of the hand (*Fig* 510) The anterior urethra (i e , as far back as the triangular ligament) is first cleansed by gentle repeated distension and emptying of the urethra with irrigating fluid This may take ½ to 1 pint of lotion The patient then relaxes and breathes slowly and deeply, at the same time 'going through the motions' of commencing urination, and the irrigating fluid passes back and fills the bladder The height of the douche can should not exceed 5 ft above the pelvis Irrigation should be carried out two or three times daily until the stage of the profuse discharge is passed

Fig 510—Self irrigation of male patient.

Soiling of the underlinen by discharge may be prevented by gonorrhœa bags or by a square of lint pinned on the under vest, and discarded when soiled

The Subacute and Chronic Stages—When as a result of irrigation the discharge has become scanty and mucopurulent, with only a moderate amount of pus and few if any gonococci in the smears, and the urine in the first glass is clear + threads, and clear in the second, the subacute stage has been reached, which in the absence of treatment merges imperceptibly into the chronic stage Investigation for infection in the prostate and seminal vesicles, and of the anterior urethra for infection of the gland ducts of Littre or the lacunæ of Morgagni, or for submucous infiltration, is indicated

Palpation and massage of the prostate and vesicles (*see* p 249), examination of smears from the expressed secretion, and haze, threads, or casts in the urine passed after massage, indicate the degree of prostatic involvement Treatment is primarily by prostato-vesicular massage twice weekly The patient should urinate immediately after prostatic massage, or the bladder may be filled with lotion, e g , oxycyanide of mercury. In refractory cases, instillation of glycerin, 1 drachm once or twice weekly, through an Ultzmann cannula (*Fig* 511) or soft rubber catheter attached to a Record syringe, into the prostatic urethra, massage on a curved bougie, or diathermy may assist in establishing adequate drainage, while in cases of vesicular occlusion, vasostomy and irrigation of the vesicles with colloidal silver may be indicated

Prostatic investigation should precede the instrumental investigation of the anterior urethra for involvement of the various glandular structures and infiltrations The more marked degrees of the glandular involvement may be diagnosed by palpation of the anterior urethra on a straight bougie—the infected gland ducts being felt like small lead shot in the wall of the urethra—or by passing an acorn-tipped bougie This is passed to the triangular ligament and slowly withdrawn Non-draining glands may be felt as slight obstructions, the patient often

Fig 511—Ultzmann's prostatic cannula

experiencing a twinge of pain Submucous infiltrations are felt as roughened tender patches Lesser degrees which may be equally guilty in causing persistence of symptoms may only be recognizable by the urethroscope Treatment is by massage on a straight bougie, dilatation by means of Kollmann's four-bladed dilator (*Fig* 512), or suction by Mills's fenestrated bougie (*Fig* 513) Instrumentation should be carried out at weekly intervals, and should be followed by

Fig 512—Kollmann's dilator

Fig 513—Mills's suction bougie

irrigation The lotions commonly used in the subacute or resolving stages are 1–6000 zinc permanganate, 1–2000 zinc sulphocarbolate, 1–5000 oxycyanide of mercury, etc, the frequency of irrigation being gradually decreased

It is essential that the course of treatment should be controlled by frequent bacteriological examination of smears, etc, and continued until the tests are satisfactory

The routine use of a polyvalent detoxicated vaccine has proved a valuable adjuvant

Chemotherapy.—The principles of successful chemotherapeutic treatment may be summed up as follows (1) Accuracy of bacteriological diagnosis and investigation as to anatomical involvement, (2) Adequate dosage for adequate period, (3) Maintenance of good drainage of the areas involved, (4) Adequate observation period (tests of cure) to exclude possibility of carrierism and late relapse

The drugs commonly employed now are sulphonamide-P, sulphapyridine (M & B 693), and thiazamide (M & B 760) The dosage of sulphonamide P is 1 g q d s for three days, followed by 1 g t d s for six days The best results

with this drug are obtained by delaying treatment for 10 to 14 days after diagnosis to allow the development of the natural immunity processes alternatively these may be stimulated by twice weekly injections of polyvalent vaccine This period of delay may entail some slight risk of extension of the disease The dosage of '693' is similar and administration should be commenced on completion of diagnosis The recommended dosage of thiazamide is 1 g q d s *for five* days Alternatively a dosage of $\frac{1}{4}$ g sulphapyridine or $\frac{1}{3}$ g thiazamide per stone body-weight daily for one week have been recommended

The administration of potassium citrate 30 gr q d s during the course of drug treatment has lessened the occurrence of nausea and vomiting The usual precautions in the administration of these potentially toxic drugs must be observed Intolerance may be prevented by the administration of vitamin C or nicotinic acid (mg 50 to 100 t d s), these latter are of value in the treatment of established intolerance

The sulphonamides show great rapidity of action—in the majority of cases so treated the discharge ceases in from three to five days and the urethra becomes gonococcus free The urinary haze may clear in this period, but more commonly takes a further three to five days The cessation of signs and symptoms does not necessarily indicate complete cure

Investigation of the prostate and vesicles and of the urethra for residual infection or non-draining foci should be instituted latency of infection, and early or late relapses, are invariably associated with non-draining foci in the genital tract Inadequate dosage of, or intolerance to, the selected drug, the ingestion of alcohol during treatment, and infrequently drug-resistance of the gonococcus are other factors in the persistence of infection Early relapses (within four weeks of cessation of treatment) in general show a frank urethral discharge late relapses, on the other hand, may show a scanty or intermittent urethral discharge with almost clear urines, yet the gonococcus is demonstrable in urethral and prostatic smears

Genuine relapses have been noted as late as seven months after apparent cure, latent infections may give rise to a symptomless infection of the consort or spouse, subsequent transfers from such symptomless carriers revert to the normal clinical type of disease

The treatment of 'relapse' cases is by (1) Searching out and eradicating the residual focus of infection, (2) Vaccine therapy, and (3) Further sulphonamide treatment. Relapse cases may react better to another type of drug than the one originally employed Pyrexial measures may be required

Treatment of Common Complications of Acute or Subacute Stages—

Peri urethral Abscess—If the abscess is small, expectant treatment with local applications, e g, of ichthyol and glycerin, may be employed If fluctuation occurs, aspiration and washing out the cavity with 4 per cent mercurochrome, or surgical incision, may be required

Acute Prostatitis and Vesiculitis—Rest in bed, cessation of urethral treatment, atropine sulphate (gr $\frac{1}{75}$) and antifebrine (gr 4) or morphia (gr $\frac{1}{4}$) suppositories, hot hip-baths, and hot rectal lavage are the main indications Calcium salts intravenously (10–20 c c 10 per cent lævulinate or gluconate, or 10 c c 10 per cent chloride or thiosulphate) daily for from three to six days or the sulphonamides give rapid symptomatic relief Treatment after the acute stage is passed should be as indicated for subacute prostatitis

Epididymitis—The local measures include rest, cessation of urethral treatment, support of the scrotum by a pillow or a suspensory bandage, and applications

of ichthyol and glycerin, lead and opium, or antiphlogistine Pain is rapidly controlled by intravenous calcium salts or by the sulphonamides When the acute stage is passed, resolution of the epididymal swelling is accelerated by massage with ung hydrarg ammon or iodex The associated prostato-vesiculitis must be eradicated

Metastatic Complications—In arthritis, tenosynovitis, and gonorrhœal rheumatism local treatment is, on general principles, directed first to the relief of pain by splintage and local applications, and later to restoration of function by massage and movement, along with eradication of the genito-urinary focus

Tests of Cure—Tests of cure, to be complete and of value, necessitate repeated observations over some considerable period of time In cases treated under the old regime, a period of from six weeks to three months was considered essential, this is equally essential in cases treated by sulphonamides, and should be exceeded in cases of intolerance, etc.

The tests of cure may be summarized —

1 Absence of signs and symptoms

2 Normal clinical findings, normal urethroscopic findings Urethra permits passage of full sized curved bougie

3 Negative smears and cultures from urethra, prostate, and vesicles Provocatives may be employed, e g, by injection of ½ c c polyvalent gonococcal vaccine, passage of a full sized metal bougie, or irritation with 1–5000 silver nitrate solution, 24 to 48 hours before the taking of the test specimens The possibility of pus due to the chemical irritation or trauma of provocation must be borne in mind, this will clear rapidly without treatment

4 Negative blood-Wassermann reaction. Period of observation should be sufficiently long to exclude a coincident syphilis

5 Negative gonococcal complement fixation test

(In vaccine treated cases, or in cases showing a positive gonococcal complement fixation test due to the infection, this test may be positive at the end of treatment, but should become negative or fade greatly in strength during the period of observation. The effect of provocative doses of vaccine must be remembered)

If these tests are successfully passed, there is little risk to the individual of the later dangers of incompletely eradicated infection or of the more immediate risks of transmission of infection to others

IN THE FEMALE

The Acute Stage—The general measures already described are applicable in the treatment of acute gonococcal infection in the female Rest in bed during the menstrual period is of value in preventing extension of the disease Alternatively, liquor sedans (B P) 1 drachm q d s may be given during the period

The aim of local treatment is to promote adequate drainage from the sites of infection—the urethra, the cervix uteri, and less frequently the Bartholin glands and the rectum—and to inhibit the gonococcus by the local application of suitable antiseptics Douches (potassium permanganate 1–5000, chloramine-T 1–5000) do not adequately influence the sites of infection, although they cleanse the vagina of discharge and promote the local comfort of the patient Their value is where local tenderness or inability to attend makes other treatment impossible

Local treatment is best carried out with the patient in the lithotomy position In practice this may be obtained by asking the patient to sit on the edge of a couch, then to flex the thighs acutely on the abdomen and grasp the front of the ankle-joints with the hands A good light is essential, either in the form of an angle-poise standard lamp or Ever-ready head lamp The labia are separated and any vulval discharge is cleansed by swabbing with saline, sodium bicarbonate solution, diluted green soap solution or other suitable antiseptic Treatment of the urethra and cervix may be 'wet' or 'dry' In the 'wet' treatment the urethra is irrigated as in the male, using a shielded Janet nozzle to prevent splashing of the operator A vaginal speculum (Cusco's or Fergusson's) is then passed, the cervix being brought into view, and the cervical canal washed out through a back-flow irrigator The vagina is then mopped dry and a gauze pack moistened with glycerin, boroglycerin, or ichthyol and glycerin 5–10 per cent inserted This treatment should be carried out at least once daily during the acute stages In 'dry' treatment, irrigation is not employed After the patient has urinated, the urethra is mopped dry and antiseptic applied to its whole length by dressed-cane probe sticks, or a syringe with a Janet nozzle may be used for the topical application A vaginal speculum is then passed, and the cervix exposed The vagina and cervical canal are thoroughly cleansed by moist swabbing and dried as far as possible The selected application is made to the endocervix by dressed probe or uterine cannula Finally, the fornices and vagina are heavily powdered as the speculum is being withdrawn, and the inner aspect of the labia and vulva powdered

The applications commonly used for the urethra and cervix are ichthyol and glycerin 5 per cent, mercurochrome 1–5 per cent in glycerin, silver nitrate 1–5 per cent, colloidal silver preparations, e g, 5–15 per cent argyrol in water or glycerin, and gonopar Alternatively, styli may be used for the urethra and cervix, e g, albargin $\frac{1}{4}$–$\frac{1}{2}$ per cent, mercurochrome $\frac{1}{4}$ per cent, chloramine-T $\frac{1}{2}$ per cent in a base of ol theobrom and white wax, or spuman A satisfactory dusting powder, which may be applied by a de Vilbiss powder blower, is —

℞	Zinc Oxid	ʒi	Mag Carb Lev	ʒii
	Bismuth Subgall	℥ii	*Pulv Amyli*	ad ℥i

During the first few weeks daily treatment is essential, and according to progress the intervals are lengthened to alternate days or twice weekly, and finally weekly The course of treatment should be controlled by frequent bacteriological tests

The Subacute and Chronic Stages.—The same principles of treatment apply to the subacute and chronic stages The female urethra is liable to many of the complications found in the male In chronic gonococcal endocervicitis stronger applications are permissible, e g, 5–10 per cent silver nitrate, 10 per cent picric acid in spirit, tinct iodi mitis, applied once or twice weekly These act by cauterization, and irritation causing increased vascularity, as opposed to the hygroscopic action of the earlier applications In very resistant cases it may be necessary to consider medical diathermy, linear diathermic cauterization of the endocervix, *ionization, or dilatation, curettage, and* cauterization

Sulphonamide Treatment.—Treatment is as described for the male The most favourable time to give sulphonamide is during the menstrual period, because of the physiological drainage and increased vascularity

Treatment of Common Complications.—

Bartholinitis —Pain is relieved by hot hip baths, hot fomentations, or local applications of ichthyol and glycerin If the duct is patent, treatment is by

injection of 4 per cent mercurochrome with a Record syringe and blunt-pointed needle (a silver lachrymal needle is excellent) If the duct is occluded and the gland fluctuating, aspiration and injection of 4 per cent mercurochrome, which may be repeated if necessary, effects a cure in the majority of cases Surgical incision and drainage may be required The sulphonamides are often ineffective

Salpingitis —Rest in bed, hot hip-baths, and intravenous calcium therapy rapidly control the pain and reduce the temperature to normal The sulphonamides are almost invariably effective Owing to tenderness during the acute stages, local treatment is often impracticable apart from massive hot douches

Rectal Infection —The local treatment consists of permanganate rectal wash-outs and protargol suppositories

Pruritus Vulvæ —Painting the vagina and vulva with 1 per cent aqueous gentian violet, wet applications of 1–40 carbolic or lotio plumbi subacet. dil are of value, or painting the vulva with 1 per cent silver nitrate may give relief

Tests of Cure.—The tests of cure may be summarized (1) Absence of signs and symptoms, (2) Normal clinical findings, (3) Absence of gonococci and pus from urethral and cervical smears and negative cultures—tests repeated monthly after menstrual period, (4) Negative gonococcal complement-fixation test, (5) Period of observation—six months

During the intermenstrual periods the patient should have no treatment and should lead a normal life as regards diet, exercise, alcohol, etc

Provocation with pilocarpine nitrate (1–400 solution), silver nitrate (1 per cent solution), or vaccine (½ c c polyvalent gonococcal vaccine) should be employed twenty-four hours before each test

CHAPTER LXV

THE TREATMENT OF SYPHILIS AND CHANCROID

By A E W McLachlan

SYPHILIS

The diagnosis of syphilis depends on the symptoms and clinical signs, the demonstration of *Sp pallida*, and in other than early primary cases a positive blood-Wassermann reaction From the point of view of treatment, syphilis falls into one of several categories —

Early infective syphilis	W R negative primary syphilis W R positive primary syphilis Secondary syphilis
Late syphilis ('tertiary' syphilis), not necessarily infective	Skin and bone lesions Cardiovascular and other visceral lesions Neurosyphilis

TREATMENT OF EARLY INFECTIVE SYPHILIS

General —Maintenance of general health, regularity of life, adequate but plain diet, regulation of the bowels, dental care if required, and abstention from alcohol and sexual intercourse are the main indications Anæmia, seborrhœa, or eczema, if present, should be treated on general medical principles

Local —Pending diagnosis, antiseptics should not be applied to the sore Saline and sulphur powder control sepsis and do not prevent demonstration of *Sp pallida* After diagnosis, 33⅓ per cent calomel cream or a dusting powder of equal parts of calomel and calamine may be applied to the primary sore, condylomata, etc Mouth lesions should be treated with gargles, e g , potassium chlorate, alum and borax, or peroxide of hydrogen Chancres concealed under the prepuce may necessitate dorsal or lateral slits or complete circumcision on general surgical principles Skin lesions in general require no local treatment Infectivity is rapidly controlled, and healing prompt under specific therapy

Specific —The drugs used are, in order of therapeutic efficiency, the neoarsphenamines, bismuth preparations, mercurials, and iodides

Neoarsphenamines (e g , N A B , neokharsivan, novostab, stabilarsan) —These are given intravenously in dosage from 0 3 g to 0 75 g , dissolved in 10–20 c c sterile doubly distilled water, 10 per cent sodium thiosulphate, 10 per cent sodium iodide, or 20 per cent glucose solution Where the intravenous route is impracticable, sulpharsphenamine (e g , sulfarsenol, sulphostab, kharsulphan, etc) may be given intramuscularly (dose 0 3–0 6 g) dissolved in 1–2 c c of sterile distilled water Mapharside (arsenoxide), a recently introduced arsenical, may be substituted for the neoarsphenamines—dose 0 04 to 0 06 g intravenously, dissolved in 10 c c sterile distilled water

Prior to injection, the patient should have fasted for two hours and should refrain from a heavy meal for two hours after injection Glucose (glucose ℥ss,

sod bicarb gr xx, ol limonis ℳi, aq ad ℥iii–iv) may be given by mouth half an hour before injection to increase the glycogen content of the liver and prevent reactions The urine should be tested for bile and albumin The ampoule of drug should be examined to exclude faults oxidation of the drug causes toxicity and is shown by darkening of the colour (compare with another ampoule of the same batch) The dose is completely dissolved in the chosen vehicle The syringe and needles should be sterilized and freed from antiseptics or spirit by washing in distilled water

Bismuth Preparations—Liposoluble bismuth (bivatol, neocardyl, stabismol, etc) is given in dosage of 0 06–0 1 g intramuscularly twice weekly Insoluble salts, e g , oxychloride, or metallic bismuth may be given intramuscularly in the upper outer gluteal quadrant in dosage of 0 2–0 3 g once weekly The liposoluble preparations exert a more rapid action, but are rapidly excreted, whereas the insoluble salts are more slowly absorbed from the tissues and have a more prolonged influence on the infection

Mercurial Preparations—*Oral administration* of liq hydrarg perchlor 1 drachm t d s , pil hydrarg c cret 1 gr t d s , etc , is of value in tertiary skin, bone, cardiovascular, and visceral syphilis *Inunction* of mercury is now seldom practised 1 drachm of ung hydrarg is thoroughly rubbed into a different area of the body daily—the limbs, abdomen, back, in rotation, avoiding hair-bearing areas

Intramuscularly mercury is given as Lambkin's or Squire's cream (metallic mercury) 1 gr weekly, or mercury salicylate 1½ gr weekly Mercury has to a great extent been displaced by bismuth

Iodides—Iodides may be given by mouth (potassium iodide 15–60 gr t d s), or intravenously (10–50 c c 10 per cent sodium iodide) They have little action on the spirochæte, but are of value in 'dissolving' syphilitic granulomatous tissue

Courses of Treatment—Dual therapy with neoarsphenamine and bismuth in courses of 10 weeks, with a rest of 2 to 4 weeks between, gives excellent results

DOSAGE FOR 10-WEEKS' COURSE

WEEK	NEOARSPHENAMINE	BISMUTH
1	0 45 g	0 2–0 3 g
2	0 6 g	0 2–0 3 g
3	0 6–0 75 g	0 2–0 3 g
4	0 6–0 75 g	0 2–0 3 g
5	—	0 2–0 3 g
6	—	0 2–0 3 g
7	0 6–0 75 g	0 2–0 3 g
8	0 6–0 75 g	0 2–0 3 g
9	0 6–0 75 g	0 2–0 3 g
10	0 6–0 75 g	0 2–0 3 g
	4 65–5 55 g	2–3 g

Rest 2 to 4 weeks , repeat Wassermann reaction , repeat above course, rest, and Wassermann reaction

Three similar courses should be given after the first negative Wassermann reaction Thereafter blood-Wassermann observations should be carried out at three-monthly intervals for two years (A 'provocative' dose of '914'—

0 45–0 6 g —should be given one week prior to blood-test on at least three occasions during this period) Clinical examination of the central nervous system, and serological examination of cerebrospinal fluid for cells, globulin, Wassermann reaction, and gold-sol test, and radiography of the thorax to exclude cardiovascular lesions are made after the expiry of the two years' observation period

TREATMENT OF LATE SYPHILIS

Skin and Bone (Gummatous) Lesions—In the absence of cardiovascular or visceral lesions courses of 10 weeks' treatment, as above, should be given The dosage may have to be greatly modified because of age or intolerance The blood-Wassermann reaction may remain persistently positive Local treatment is by fomentations or mildly antiseptic protective dressings, on general principles

Cardiovascular and Visceral Syphilis—Potassium iodide and liq hydrarg perchlor or Guy's pill are of value in conjunction with bismuth and arsenicals in small dosage (0 05–0 2 g and maximum of 0 3 g respectively) Treat to the maximum of clinical improvement

Neurosyphilis—Tryparsamide (dose 1–3 g) intravenously, the drug of choice, necessitates examination of optic discs, optic atrophy is a contra-indication Silver-arsphenamine (dose 0 1–0 3 g intravenously) may be used in such cases, combined with bismuth intramuscularly Other therapy malaria or pyrexial measures are valuable

Intolerance and Toxic Reactions to Arsphenamine Treatment.—*Relative or absolute contra-indications* to the exhibition of '914' are diabetes, Addison's disease, nephritis, gross hepatic disease, tuberculosis, and alcoholism Each case should be judged on its merits where there is the possibility of a specific cause, rapid improvement should follow small dosage of '914' or bismuth

Toxic Reactions—

1 *Immediate* During or within twenty-four hours of administration of '914' nausea, a taste of garlic in the mouth, vomiting, a fainting feeling, or pain in the gums may occur, these may be prevented by slow injection of a dilute solution of the drug, the use of sodium thiosulphate or glucose as solvents, or the admixture of vitamin C A 'nitritoid' or anaphylactoid crisis—respiratory and cardiac distress, flushed face, and swelling of lips, tongue, and face—rarely occurs, and is treated by adrenaline ½ to 1 c c Headaches, rigors, temperature reaction, diarrhœa and vomiting, and transient albuminuria may occur within twenty-four hours and be associated with a Herxheimer reaction, i e, flaring up of a skin rash or other lesions For these the treatment is symptomatic Subsequent prevention is by vitamin C, calcium salts, or glucose, while further dosage of arsenicals may require modification Infrequently serious apoplexy occurs—nerve irritation, headache, inability to concentrate, epileptiform convulsions—and may be treated by adrenaline, venesection, thecal drainage (15–20 c c), or calcium salts

2 *Late* Malaise, depression, and loss of weight may occur

Jaundice may vary from a mild catarrhal type to an acute liver atrophy Treatment is by a fat-free diet, calcium thiosulphate, vitamin C, or intravenous glucose, in addition to alkaline mixtures No arsphenamine should be administered for from 6 to 12 weeks after cure

Dermatitis is predisposed to by alcohol, focal sepsis, or pre-existing dermatosis, and commences as an erythema, rapidly progressing to exfoliation Local treatment is by lin calaminæ in the early stages, bran baths or a bran bed in the

exfoliative stages, and later, oily applications More specific measures are vitamin C by mouth, or calcium or sodium thiosulphate or glucose intravenously Further arsenic is contra-indicated

Purpura Hæmorrhagica is rapidly controlled by calcium salts

Intolerance to Bismuth.—A bismuth line frequently occurs on the gums and may go on to ulcerative stomatitis Prevention is by early dental care Treatment alum gargles, application of hydrogen peroxide, or colloidal iodine give relief If gastro-intestinal symptoms or albuminuria occurs, rest from the drug is advisable

Tests of Cure.—The tests of cure of early infective syphilis have been indicated in the treatment section Where the Wassermann reaction remains obstinately positive despite long-continued treatment, cardiovascular and nervous system involvement should be excluded Long-continued observation is necessary to be certain that no reactivation is likely A positive Wassermann reaction in an adequately treated patient does not necessarily indicate infectivity and is not incompatible with a long and useful life

CHANCROID

Chancroid ulceration is rapidly healed by the sulphonamides, phagedena is prevented, and the associated bubo resolves without rupture Cauterization, e g, with 25 per cent thymol iodide in ether, acid nitrate of mercury, pure carbolic acid, or the electric cautery, is now seldom required Free drainage should, if necessary, be accomplished by dorsal or lateral slits Dressings of eusol should be applied in the first instance, later red lotion or 1–4 per cent mercurochrome ointment to stimulate healing Subsequent observation should be long enough to exclude a concomitant syphilis

CHAPTER LXVI

MEDICAL 'OPERATIONS'

By F Dudley Hart

VENESECTION

The removal of blood from a patient was once a very popular form of treatment, and in some cases blood letting is still a valuable measure The condition that benefits most markedly is chronic congestive cardiac failure, where the patient dyspnœic, distressed, and with distended veins in the neck is much relieved by withdrawal of ½ to 1 pint of blood Other indications are hypertension with symptoms of severe headache and general distress, polycythæmia vera with like symptoms, acute congestive failure with pulmonary œdema and some cases of

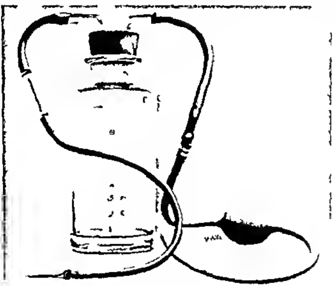

Fig 514 —Venesection apparatus

status epilepticus and acute uræmic convulsions (where the benefit is largely due to relief of the heart) Contra indications are few, given the above indications It should not be done in cases with marked anæmia

Technique —The old practice was to inject local anæsthetic over a suitable vein in the arm—such as the cephalic—and nick the vein across with a sharp lancet or tenotomy knife Such a practice is rapid and painless and is still used Bleeding stops on raising the arm and applying light pressure

For all practical purposes the following technique is most suitable Place a sphygmomanometer band round the arm high up towards the shoulder and keep

the pressure between 70 and 90 mm Hg Feel the pulse to make certain the pressure is not so high as to cause obliteration of the arterial pulse Infiltrate a small area with local anæsthetic over the most suitable vein—preferably the median cubital Take a wide-bore, conical needle with a sharp point (e g, French's needle) and attach to it a piece of sterile rubber tubing Fill the needle and tube with 3 8 per cent sodium citrate solution and clamp the bottom of the tubing Slide the needle through the area anæsthetized, just through the skin, then obliquely through the wall of the vein Hold a graduated receiver containing citrate solution below the tubing, unclamp, and collect the amount required—usually 12 to 25 oz The whole process takes about fifteen to twenty minutes The blood may clot in the needle if an unsuitable needle of too small bore is used, or if it is not correctly in the vein

Alternatively the tubing may be attached to a bottle to which some suction apparatus is connected Such an apparatus is that of Dr French. A similar apparatus may be made with a bottle, cork, and two pieces of glass tubing, to one of which is attached a piece of rubber leading to the needle, to the other rubber tubing leading to a reversed Higginson's syringe (*Fig* 514) Light suction by squeezing the bulb of the syringe prevents clotting, and makes the whole process quicker A suitable amount of citrate solution should be placed in the bottle beforehand The rubber tubing should be fairly thick-walled, as thin walled tubing may collapse on suction Before insertion into the vein, a small quantity of citrate solution should be sucked through the needle into the bottle

APPLICATION OF LEECHES

This form of treatment, once extensively used, is now rarely practised, but it is still a recognized method of relieving congestion and inflammation and allaying pain Two varieties of leech are in common use, the speckled leech (*Hirudo medicinalis*) and the Australian leech (*Hirudo quinquestriata*) They are stored in unglazed earthenware pans, half filled with soft water, with pebbles, turf, or moss in the bottom The top of the pan is covered with muslin The pan should be placed in a shady place, and the temperature of the water kept at 10° to 20° C When required for use, cleanse the part of the patient to which the leeches are to be applied, and moisten the skin with sugar water, but do not apply antiseptics to the skin Without touching the leeches with the fingers, apply the required number—usually 1 to 4—to the site elected. If they fail to bite, a small scratch with a needle on the skin will overcome the difficulty, the leech immediately taking hold Each leech draws off about 6 millilitres of blood, will fall off when sated, and should not be forcibly removed If their removal is required, a little salt dropped on their backs acts as an emetic and they immediately drop off If further hæmorrhage is needed, the part may be fomented, if not, dress the wounds lightly with a thin layer of cotton wool Excessive bleeding is checked by firm pressure or touching with a silver nitrate stick

The site of election is over the affected area—the liver in hepatic congestion, pre cordium in pericardial effusion, lung base in pulmonary congestion or pleurisy Much relief often follows their application

TREATMENT OF ANASARCA

The practice of puncturing swollen areas to relieve the patient of œdema is much less popular than it was It is purely a palliative measure, and though often attended by temporary relief has seldom a lasting effect The wounds in such swollen, waterlogged, and devitalized tissues tend to become infected, and the actual process may be very unpleasant to the patient

A cardiac bed, with the foot low, is the best method of nursing such patients A mackintosh is placed over the foot of the bed, tucked to form a gutter running

into a suitable receptacle The feet should be frequently dried and kept warm, otherwise they become cold and clammy with fluid

Two methods have been frequently used multiple small skin incisions and Southey's tubes In the former small incisions are made through the skin ½ to 1 in long, dressed with gauze and much cotton-wool, and the part wrapped in sterile towels Incisions on the dorsum of the feet seem overliable to become septic Asepsis must be rigid The legs are kept hanging down, with a mackintosh arranged as above Frequent dressings are necessary, and are continued until wound healing is complete

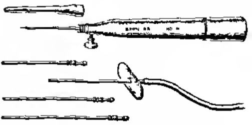

Fig 515—Southey's fine trocars and cannulæ

If Southey's tubes (*Fig* 515) are preferred, one or two are inserted into each leg *Trocar and cannula are pushed obliquely up to the hilt into the subcutaneous tissues, the trocar withdrawn, and a thin rubber tube attached, which conveys the fluid to a bottle at the foot of the bed Dressings have to be repeated* frequently, as fluid leaks round the cannula

PARACENTESIS ABDOMINIS

In certain conditions the abdomen becomes distended with fluid (1) As part of a generalized œdema, (2) Due to tuberculous ascites, or (3) Due to portal obstruction Removal of fluid in such cases may give much relief, and should be resorted to as a palliative measure when the patient is suffering much discomfort from abdominal distension Although the fluid is likely to return, it does not always do so, and after two or three aspirations no more may collect

The fluid is under positive pressure, and as it is clear and watery no difficulty is experienced in its aspiration A Southey's or other fine trocar and cannula is attached to a rubber tube, which drains into a large receptacle at the side of the bed

The best site is either in one or other iliac fossa, or in the middle line 1 to 3 in below the umbilicus, care being taken first to empty the bladder The intestine, even if touched, recedes before the cannula, and there is little chance of injuring the gut if reasonable care is taken If nothing else is available, a hollow needle of medium bore may be used

The flank is perhaps the best site, and the safest place *is just external to* McBurney's point Some 3 to 6 c c of local anæsthetic are introduced into the skin and down *to the parietal peritoneum, and the trocar* and *cannula slowly* and firmly inserted A rotary movement helps to break through a resistant skin With a binder around the abdomen, gradually tightened as the abdomen lessens in size, the fluid drains into the receptacle As much fluid as possible is removed, and a tilting of the patient to the side aspirated usually increases the efficacy of the drainage and lessens the (very slight) risk of injuring the bowel Several pints may be removed in this manner, to the great relief of the patient

MERCURIAL DIURETICS

The above-mentioned methods of withdrawing œdema fluid are only called for when other forms of diuresis are either contra indicated or fail to work

Intravenous mercurial diuretics are by far the most effective Salyrgan (Bayer), neptal (May & Baker), i e , mersalyl (B.P), contain approximately 38 per cent of mercury, and have now largely replaced other drugs and methods

Indications.—Generalized œdema as in congestive cardiac failure or chronic nephrosis

Contra-indications.—Renal insufficiency (as in acute and chronic nephritis), urinary obstruction (e g , enlarged prostate), purpuric states, recent cardiac infarction The patient should not be given the drug if he is unable to concentrate the urine above a specific gravity of 1020

Technique.—The patient is at rest in bed with fluids charted on an intake-output chart Fluid intake is best restricted to 2 pints a day One c c of the diuretic solution (e g , 1 ampoule) is injected intravenously, care being taken lest any escape from the vein as the solution is very irritating It is best given in the morning so that the action is largely over by nightfall If satisfactory diuresis is obtained 2 c c are given intravenously 2 days later, the injection being repeated every 4–5 days as desired A satisfactory response is anything from 2–8 pints increase in output over intake a day The drug may also be given intramuscularly, but the effect is much less dramatic

Undesirable effects may be vomiting, nausea, stomatitis, diarrhœa, fever, abdominal pain or discomfort, headache, hæmaturia, or (rarely) circulatory collapse In some cases no effect is obtained, good or bad , in such cases ammonium chloride, gr xxx, in capsule form may be given four times daily for 2–3 days prior to the injection

SPLENIC PUNCTURE

Splenic puncture as a diagnostic measure is—with reasonable care—a safe procedure, and may be required in splenic enlargement where Gaucher's disease is suspected In kala-azar it is apt to be dangerous, and liver puncture is safer

Technique.—Fix the enlarged spleen firmly against the lower border of the ribs The organ is now felt quite superficially under the palpating fingers Insert a large-bore needle with syringe attached, push in until the point is well into the spleen, and aspirate a portion of tissue into the needle Keep up the negative pressure while withdrawing the needle Apply firm pressure on the needle wound for two minutes with a swab

The same technique may be used when the usual biopsy is impossible in soft tissues elsewhere Aspirate the tissue—e g , malignant glands of the neck —and, with negative pressure maintained in the syringe, give the needle a lateral jerk before withdrawal This detaches the tissue aspirated, and prevents it being left behind on withdrawing the needle

BONE-MARROW BIOPSY

In certain blood diseases it is of great advantage to ascertain what changes have taken place in the blood forming tissues The sternum is the most suitable bone, for it is superficial and accessible and the marrow changes are there early and well marked Some cases of leukæmia can only be diagnosed with certainty by sternal biopsy

Technique.—The marrow may be aspirated through a medium-bore needle quite easily, but in some cases (e g , aplastic anæmia and myelosclerosis) it is desirable to examine the histological structure of the blood-forming tissue In such cases local anæsthetic is injected over the site of election near the centre

of the body of the sternum, using a fine needle with short bevel, the skin, subcutaneous tissues, and periosteum being infiltrated An incision is then made and the periosteum cut and retracted With a small trephine an area of bone 1 cm in diameter is removed, together with a small spoonful of marrow The latter is transferred to a sterile test-tube containing Wintrobe's mixture (*see below*), the bone space is packed with bone wax, and the periosteum and skin are sutured

If simple aspiration of marrow tissue is all that is required, this may be done in one of two ways —

1 Feel for the sternomanubrial junction, infiltrate the overlying soft tissues with local anæsthetic down to the bone, and, using an 18 gauge spinal puncture needle, push obliquely in at an angle of 60° to the surface of the chest in the midline Now depress the angle of the needle to about 30° The point enters the marrow of the body of the sternum Remove the stylet and aspirate 0 25 c c of marrow, using a dry 1-c c syringe Do not go deeper than 1 5 cm, and rotate the needle, exerting pressure all the time, if resistance is encountered Transfer the aspirated matter, which strongly resembles blood, from the syringe to a sterile test-tube containing Wintrobe's dry oxalate mixture (For 0 25 c c. of fluid place 0 1 c c of a solution of 0 2 per cent potassium oxalate and 0 3 per cent ammonium oxalate in the tube and dry in the incubator) The marrow fluid clots very rapidly, so thorough mixing with the oxalate mixture should not be delayed Direct smears may be made if the fluid is not to be immediately examined The procedure is best done from the head of the bed, the patient lying on her back with the sternum prominent and her head thrown back In children, and with some adults, it is wise to administer chloral or luminal 30 to 40 minutes previously

Fig 516—Sternal puncture needle and stylet

2 The second (and preferable) method is to use a special short bevel needle of medium bore with sharp point and adjustable guard (*Fig* 516) An area near the centre of the body of the sternum opposite the third rib is infiltrated with local anæsthetic down to and including periosteum, and the needle is thrust through the area anæsthetized until the point touches bone The guard is now adjusted so that it is some 3 mm from the skin surface, and with a few sharp taps with a small hammer the needle is driven through the outer table into the marrow Aspiration is effected as above, 0 25 c c being added to the oxalate mixture If the point of the needle is in marrow, aspiration is as easy as from a vein

Sternal puncture may be performed at any age, but in childhood the aspiration should be from the centre of the manubrium sterni and the needle should be gently pushed through by hand, not driven by a hammer Premedication is desirable Both in adult and child the procedure is free from complications and is painless but for a drawing sensation in the sternum during the actual aspiration This is not severe and tells the operator that the aspiration is proceeding normally

FRACTIONAL TEST-MEAL PROCEDURE

To ascertain the stomach contents before and during digestion, the fasting juice is taken off first thing in the morning, the meal given, and samples of the

stomach contents withdrawn and analysed for total acid, free hydrochloric acid, starch, and bile Mucus and blood are noted if present

It should not be forgotten that an apparent achlorhydria is often due to apprehension or nausea, rendering the first test meal result unreliable Should there be an apparent achlorhydria, a histamine test-meal should be performed This consists of giving an injection of 0 5 mg histamine acid phosphate in 1 c c of water subcutaneously after the fasting specimen has been withdrawn, and taking further specimens every ten minutes for an hour Certain patients react unduly towards the drug, and it should not be given to weak and very debilitated subjects, nor to anybody with a systolic blood pressure under 100 mm. Hg Children may receive anything from 0 1 to 0 3 mg according to their age Neither a histamine nor a fractional test meal should be performed if there is aneurysm of the aorta or uncompensated heart disease, nor should it be done shortly after severe gastric hæmorrhage

An alternative meal is the alcohol test-meal After a twelve hour fast, which includes the ingestion of no water for several hours before the meal, the tube is swallowed and a fasting specimen withdrawn as before Empty the fasting stomach as completely as possible Introduce 50 to 100 c c of 7 per cent alcoholic solution, and after five minutes withdraw specimens every twenty minutes for eighty minutes

Technique—The test is done on a fasting stomach If the patient is on milk feeds, the last feed is given at 10 p m

At 5 a m a Ryle s tube is passed to the second mark on the tube, and the resting juice is withdrawn from the stomach by means of a Record syringe This is put into a test tube labelled 'resting juice', the amount being measured The free end of the Ryle s tube is lightly fixed to the patient's cheek with adhesive tape, and a spigot inserted The patient is then given prepared oatmeal—one pint (To prepare the oatmeal for this test boil two tablespoons of fine oatmeal in two pints of water until the quantity is reduced to one pint, and then flavour with salt unless estimation of chlorides is to be done) Twenty minutes later the first specimen is withdrawn and put into a test tube labelled '1' Other specimens are withdrawn at intervals of twenty minutes until ten in all have been obtained, the test tubes being labelled numerically Approximately 5 c c. are taken for each specimen

INDUCTION OF ARTIFICIAL PNEUMOTHORAX

Induction of an artificial pneumothorax is the procedure by which air is introduced into the pleural cavity, so separating the surfaces of visceral and parietal pleuræ, lowering the negative pressure in the pleural sac, lessening the normal tension of the lung, and so allowing relaxation and partial rest of that organ It is a passive partial collapse, and in no sense an active collapse by compression The circulation through such a collapsed lung is decreased

Indications—The usual indication for induction of an artificial pneumothorax is pulmonary tuberculosis with cavitation It is also performed (*a*) For diagnostic purposes to decide whether a tumour is in the lung or chest wall, (*b*) To ease pain by separating the inflamed parietal and visceral pleuræ in severe pleurisy, (*c*) Prior to thoracoscopy, (*d*) For certain other conditions mentioned in this chapter

Apparatus—Many types of apparatus are on the market, of which that of Maxwell (*Fig* 517) is perhaps the most compact. The most commonly used in is the Lillingston Pearson apparatus, as it is simple and easily

Fig 518 shows the apparatus ready for use Coloured water is present in the two bottles For an induction the fluid levels in both bottles are equal when ready for use, for a refill Bottle I is full and Bottle II has fluid up to the zero mark If an air lock prevents the flow of fluid from I to II the mouth is applied to the open glass tube in

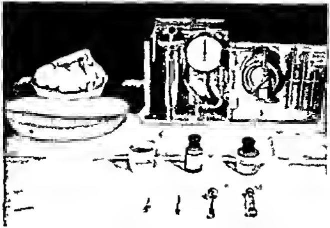

Fig 517.—The Maxwell artificial pneumothorax apparatus with induction and refill needles in the rack Local anæsthetic (2 per cent procaine) and adrenaline in case of pleural shock

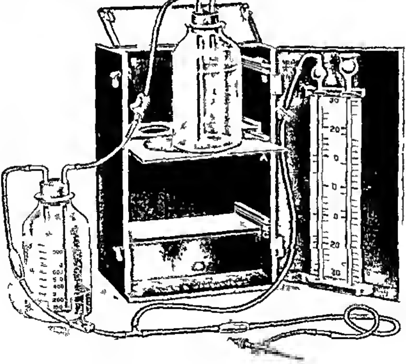

Fig 518.—The Livingston Pearson artificial pneumothorax apparatus

Bottle I and a few cubic centimetres of fluid are blown from one bottle to the other to start the flow. The coloured water in the manometer should be level with the zero mark before starting.

The principle is simple. When fluid flows from Bottle I to Bottle II the air in the latter is forced along the rubber tubing through two cotton-wool filters and so through the needle into the pleural sac. To start the flow the tap on the needle is opened, and the clips on each side of Bottle II are opened. The amount of air introduced is read on Bottle II—i e, if the fluid level has risen from zero to 600, 600 c c of air have been introduced. Readings are taken from the left limb of the manometer, a negative reading being shown by a rise above zero, a positive by a fall. Care should be taken to pinch the tube if the patient coughs, for the high positive pressure so caused may blow the fluid out of the manometer. For an induction an induction needle such as Riviere's (*Fig* 519) or Kuss's (*Fig* 520) is used. On withdrawing the trocar care should be taken that the cap does not leave the end of the needle, for if this occurs the pleural sac is thrown open to the room air. This will not happen if it is first seen that the cap is firmly screwed on. Refills are done with refill needles such as Saugmann's (*Fig* 521). As soon as the point is in in the pleural space the stylet is withdrawn, the tap turned on, and the air introduced.

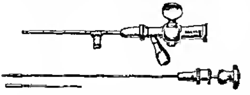

Fig 519.—Riviere's needle

Technique of Induction of an Artificial Pneumothorax.—The apparatus is placed on a table or trolley alongside the bed with all taps closed and the fluids at equal levels in the two bottles. The patient lies comfortably flat on the bed on his unaffected side with only one pillow to support his head. His arm is thrown upwards in front of his face to expose the axilla on the affected side. After cleaning the skin an area over the site of election—usually the 4th to 6th space in the mid or anterior axillary line—is infiltrated with 5 to 8 c c of local anæsthetic, care being taken to raise a small bleb in the skin, to avoid the ribs, and to infiltrate right down to the parietal pleura. The induction needle is then attached to the apparatus, and with a rotary movement the needle is passed through the skin and down between the ribs. When the pleura is reached the trocar is withdrawn and the cannula passed through the parietal pleura into the pleural sac. The needle tap is turned on, and a negative excursion on the manometer shows that the cannula is in the pleural sac. Any excursion on the manometer of less than 3 cm is discounted. A common reading is −16 −11, an excursion of 5 cm, but anything from −30 −36 to −6 −2 may be seen. A reading of −1 +1 means that the end of the cannula is in the lung, and it should be gradually withdrawn until a suitable reading is obtained. A gradually rising positive pressure indicates that the cannula is in a blood vessel, and it should be

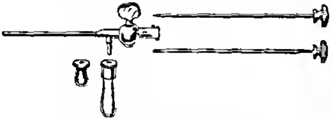

Fig 520.—Kuss's needle

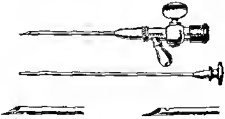

Fig 521.—Saugmann's refill needle.

withdrawn before blood flows through the rubber tubing into the apparatus If no reading at all is obtained, either the cannula is in the chest wall or a pleural effusion, or the needle or tube is blocked *The trocar should be passed into the cannula and* the tubing pinched several times to make certain this is not so If still no reading is obtained it is likely that the lung is adherent in this area, and the process should be repeated in a fresh place—preferably in the 7th or 8th space posteriorly The third and last site to be tried is high in the axilla or in the 2nd to 4th spaces anteriorly, care being taken to avoid the heart and great vessels

When a suitable reading is obtained the taps are turned on, allowing the air to be *sucked* into the chest by the negative pressure in the pleural sac As the fluid level falls in Bottle I it may be raised so that the fluid levels remain equal in the two bottles Any amount of air from 100 c c to 300 c c is introduced

The final pressure should be a negative one, and the tap should be closed periodically to take a reading A slight excursion throughout the induction is seen on the manometer which indicates that the cannula is still in the pleural space A common reading obtained is −16 −12 250 c c −13 −9 On no account should the pressure be left positive A reading such as −12 −12 100 c c −2 +2 means that adhesions are present between visceral and parietal pleuræ and only a small pocket of pleural sac has been filled with air *The final reading should not be lower than −4 −0* The needle is then withdrawn, the puncture wound covered with cotton wool and collodion, and the patient ordered absolute rest for the subsequent twenty four hours, lying on the side most comfortable to him—preferably the side induced He is asked not to cough, and is given linctus codeinæ if a troublesome cough is present

A possible danger must be emphasized An intractable cough arising during induction may be due to puncture of the lung This usually occurs when anæsthetizing the deeper structures, moreover, the sudden inspiratory movement may break off the needle in the chest wall

Complications.—

1 *Bleeding from the puncture wound* This is easily controlled by a pad and firm pressure for ten minutes

2 *Pleural shock* At any time during the induction the patient may become shocked His pulse becomes weak and rapid, his blood pressure drops, and his skin becomes cold, pale, and clammy The induction is immediately stopped, restoratives are given

Fig 522—Artificial pneumothorax If too much air has been introduced into the chest elevation of Bottle II of the artificial pneumothorax apparatus sucks some air back. Note the positive pressure on the left limb of the water manometer (+ 7)

and the patient is treated for shock The cause of this complication is unknown Adrenaline *should* always be kept on the trolley, and 5 to 10 *min* of 1–1000 solution injected immediately subcutaneously

3 *Tightness or discomfort in the chest* In mild degree this is of no significance, but if severe the patient should be examined to ascertain if the breath-sounds are absent, the percussion note hyper resonant, or the heart displaced Any of these signs may indicate

a superadded spontaneous pneumothorax caused by the tearing of a pleural adhesion or laceration of the lung A refill needle is inserted and a reading taken. If a positive pressure is present, air should be gradually withdrawn until the patient is eased This is done by reversing the flow in the two bottles, so that the fluid runs from Bottle II to Bottle I (*Fig* 522)

4 *Subcutaneous emphysema* A mild degree of this is commonly present after induction and is of no significance

5 *Hæmoptysis* This probably means that the lung has been injured by the trocar during induction It is never severe The patient is reassured and told that slight staining of the sputum may persist for some hours but is of no significance

Refills —After the induction of an artificial pneumothorax a refill should be performed after twenty four hours, and subsequently (if desired) after 2, 4, and 8 days, maintaining the collapse at weekly intervals as found necessary Thus the refills would be spaced Day 1, induction, Day 2, refill, Day 4, refill, Day 7, refill, and so on, missing a day each time until weekly intervals are reached. Satisfactory collapse is usually not achieved until the fourth or fifth refill Refills (*Fig* 523) are performed

Fig 523 —A refill of an artificial pneumothorax in progress Note negative pressure on manometer

with a suitable refill needle, using the same technique as for an induction. The fluid is run from Bottle I to Bottle II, the latter starting with the fluid level at zero The amount of air introduced is read, and varies from 200 to 800 c.c. The first three refills should not exceed 500 c.c It is rarely necessary to give more than 700 c.c at any fill. The final pressure should never be positive, i e, should not exceed −2 ∓ 2 Bottle I may be raised slightly to accelerate the procedure

The only physical sign after the induction of an artificial pneumothorax is lessening of the breath sounds on that side After two or three fills the breath sounds may disappear completely, but the percussion note remains normal A mediastinal shift may or may not occur, and is of little or no significance after the 3rd refill unless extreme and or causing symptoms

AIR REPLACEMENT OF A PLEURAL EFFUSION

The patient sits on a couch with his head and shoulders upright For comfort it is better to have his back supported, as the replacement, if difficult, may take time He puts the arm on the affected side well forwards to expose his axilla, and leans slightly to the opposite side

Two areas are infiltrated with local anæsthesia, one high in the axilla between the 3rd and 4th or the 4th and 5th ribs, the other lower in the 7th interspace in the posterior axillary line, in the 6th space in the mid axillary line, or posteriorly in the 7th–8th space below the angle of the scapula Two such areas are anæsthetized, and a small portion of fluid from both areas withdrawn into the syringe, to make certain fluid is present at both sites

Into the lower area an aspirating needle is inserted and connected with the aspirator Commonly used types are Dieulafoy's and Potain's The latter has certain disadvantages, but is the model to be found in most hospitals Its chief drawback lies in the irregularity of its suction, but for general purposes it is a very useful apparatus Dieulafoy's aspirator is a large syringe with a two-way cock

Through the upper area an artificial pneumothorax refill or induction needle is inserted and connected up with the artificial pneumothorax apparatus. *If fluid extends* above the site of the upper needle—as shown by aspiration of a few drops into the local anæsthetic syringe—a refill needle is used. If not, an induction needle, and readings are taken from the start.

Aspiration is commenced, and the upper needle kept closed if in fluid. After some 10 oz. have been withdrawn, insert air via the upper needle from the artificial pneumothorax apparatus (*Fig.* 524). Continue the aspiration, never allowing air to enter from above faster than fluid is escaping below. As the fluid level sinks below the upper needle a swing in the manometer of the artificial pneumothorax apparatus becomes

Fig. 524.—Air replacement of a pleural effusion. Potain's aspirator is on the left of the picture, the needle to be inserted into the chest at the lower mark. The Lillingston Pearson *artificial pneumothorax apparatus is on the right, the needle to be inserted at the upper mark* on the chest wall.

apparent. The intrapleural pressure is kept slightly negative—a swing of −6 −2 is suitable. *A high negative, such as −12 −8, means* that too little air has been introduced and too much fluid removed. When the flow becomes less steady through the aspirator and interrupted by air-bubbles, let the patient lean over to the affected side. In this way all the fluid may be aspirated.

The final reading is then taken, and should be slightly on the negative side. Both needles are removed, the puncture wounds covered with cotton-wool and collodion, or cotton-wool alone, and the aspirated fluid and introduced air measured.

It is unnecessary and unsatisfactory to aspirate lower than the 7th–8th space, as mentioned above. All fluid can be removed by aspiration at this level. Thick fluids—pus or sero-fibrin—will require stronger suction than is necessary with a clear fluid, and Potain's or Dieulafoy's aspirator is the apparatus of choice. Sometimes no aspiration can be effected until a small pocket of air is introduced through the upper needle. In such a case 100 to 200 c.c. of air are slowly introduced from above as aspiration is attempted below. A thick fluid will then sometimes come through a wide bore needle when aspiration was previously a failure.

TREATMENT OF HÆMOPTYSIS

Hæmoptysis, if copious, *may cause sudden death*. The cause is almost always bleeding from a ruptured artery in a cavity; such a cavity is usually of tuberculous origin. Hæmorrhage may also occur from bronchiectasis, new growth, and various other lesions. The patient may become drowned in his own blood, which is partly coughed out and partly inhaled into all parts of the lung. Inspiration of blood may cause massive collapse.

Treatment.—The immediate treatment is to lower the head over the side of the bed if the patient is choking, and *allow the blood to flow from the lung bases towards the* bifurcation of the trachea, whence it will be coughed up. Usually the bleeding is too slight to warrant this procedure. Morphine always does more good than harm, as such

a patient is anxious and terrified at the sight of his own blood, and imagines death to be imminent Nothing seems to soothe as much as morphine Only ¼ gr should be given, for tuberculous subjects seem to respond more readily than others to the injection The patient is ordered absolute rest If bleeding continues, and the signs of cavitation, clinical and/or radiological, are present on one side, induce an artificial pneumothorax on that side Often the patient will tell you from which side the blood is coming Complete collapse of the cavity for hæmoptysis necessitates introduction of much more air than is permissible in any other condition at one fill Anything up to 1200 c c. may be introduced, but at the first sign of distress the procedure should be stopped Usually only 400 to 600 c c are necessary Shift of the heart and mediastinum does not matter if no distress is caused. The fill should be repeated if bleeding continues Such a measure should only be adopted if hæmoptysis is copious and bleeding is continuing, as shown by the usual signs of hæmorrhage In these cases collapse of the lung may be a life saving measure, and the artificial pneumothorax is maintained afterwards to prevent the lung from re-expanding

TREATMENT OF SPONTANEOUS PNEUMOTHORAX

The usual causes are rupture of an emphysematous bulla or pulmonary tuberculosis A patient with an artificial pneumothorax may rupture an adhesion containing lung tissue and develop a spontaneous pneumothorax in addition Symptoms may be absent or slight, or there may be severe pain in the side, palpitations, or shock The onset is acute Diagnosis is made on the signs of a displaced heart and absence of breath sounds on one side The percussion note is usually hyper-resonant, but not always so

Treatment.—Take a radiograph to verify the diagnosis unless the condition is urgent Insert an artificial pneumothorax needle into the affected side, connect with the artificial pneumothorax apparatus, and take a reading Instead of the normal negative pressure (about −14 −8) the swing shows −2 −2 or a positive reading such as +2 +6 If not distressed the patient is left severely alone, if short of breath and in pain remove sufficient air to give him relief, but no more than 700 c c at one time The air is withdrawn by reversing the flow in the bottles of the artificial pneumothorax apparatus If acutely urgent and the physical signs are such as to warrant the diagnosis, and if no artificial pneumothorax apparatus is to hand, thrust into the chest any wide-bore needle The best site is in the 7th space in the axilla, but almost anywhere between 2nd and 9th ribs will do The air will be heard to rush out if under great pressure This often occurs where a valvular leak is present, allowing air to enter the pleura but none to leave If the dyspnœa is increasing, a valvular pneumothorax is almost certainly present In such a case leave the needle in and attach to it a rubber leading to a glass tube placed in a bottle containing water at the side of the bed When the patient coughs bubbles will appear through the tube only if the fistula has persisted

If fluid appears in the pleural space the condition is probably tuberculous, if not, probably non tuberculous The latter cases are common, and almost all get well on rest alone, no removal of air being necessary If the lung in such a case is slow in re expanding, removal of air occasionally may accelerate the process

CHAPTER LXVII

VACCINATION

By Allan H Morley

It is extremely probable, though not conclusively proved, that vaccinia (or cow-pox) is variola modified by natural spread to animals Both are inoculable, and mutually protective, but vaccinia only spreads by inoculation

Nowadays *glycerinated calf lymph*, supplied in capillary tubes, is used almost exclusively for vaccination, although it is possible to use lymph from ripe vesicles The lymph should be kept in a dark cool place, and it is best not to use lymph which has been removed from cold storage for more than seven to ten days

Two main principles should be observed —

1 The production, with a fair degree of certainty, of a satisfactory vaccinia with the minimum of injury to the tissues

2 Complete asepsis, and this should be maintained until a firm protective scab is formed

Unless exposure to small-pox has occurred or is expected, it is recommended that only one inoculation be made in primary vaccinations

Technique —

The site usually selected is the outer side of the arm in the region of the deltoid, except when a scar on the arm is considered undesirable, in which case a suitable site is the outer side of the leg about 1 in above the external malleolus In older children or adults the thigh is a suitable site, but in the case of infants there is the difficulty of keeping it dry The selected site should be freed widely of all clothing and then swabbed with cotton wool soaked in ether, the inflammability of which must, of course, always be borne in mind Spirit may be used instead, but is not so satisfactory unless it is rectified Friction should be used to cause slight congestion of the skin, and then the contents of a tube of lymph are evacuated on to the site by means of an artificial blower This can be obtained from an instrument maker, but an entirely satisfactory one is a teat from an infant's feeding bottle, with a round hole at the tip The unbroken tube of lymph is passed through the hole into the cavity of the teat until the end projects through the open end of the teat (*Fig* 525) This end is then broken off and the tube pulled out again in the reverse direction until only a small portion remains inside The other end of the tube is now broken off, and by compressing the open end of the teat the contents of the tube can easily be blown on to the vaccination site

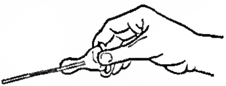

Fig 525 —Method of transferring lymph from the capillary tube

Scarification is the method which still secures general acceptance in practice, and this operation is performed when the site has been prepared The skin should be stretched slightly while the scratching is made through the drop of

lymph until the superficial layers of the skin are penetrated, and the appearance of a tiny area of redness shows that some capillaries have been laid bare It is undesirable to cause actual bleeding Scarification may be performed by means of a special instrument resembling a minute fork, obtainable from instrument-makers, with a lancet, or simply with a needle Sterilization of the instrument is best produced by holding it for a few moments in the flame of a spirit or 'Meta' lamp. After scarification it is wise to allow time for the lymph to show definite signs of drying in

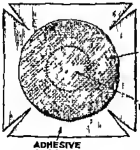

Fig 526 —An excellent dressing after vaccination

Finally, a *protective sterile dressing* is desirable The most suitable is a self-adhesive pad made of plain white lint and zinc oxide plaster An important point is that if plaster is used it should not be allowed to cover the whole of the lint (*Fig* 526) A good-sized hole should be present to allow evaporation, or the site will become sodden and risk of infection occur Instructions should be given that the dressing must be kept dry Inspection of the result should be made between the seventh and tenth days in the case of primary vaccinations (*Fig* 527), and between the fifth and seventh days in the case of re-vaccination

Fig 527 —A typical successful vesicle of primary vaccination at maturity on the ninth day

In primary vaccination a *papule* appears about the third or fourth day and this becomes a *vesicle* on the fifth or sixth day An inflamed red areola appears and the vesicle enlarges till (as shown in illustration) *incrustation* begins in the centre, about the ninth day *Decrustation* and *scarring* follow in due course These stages are remarkably constant in their manifestation in the case of primary vaccination, but all the stages in secondary vaccination tend to be shorter and less clearly defined, depending on the remaining degree of immunity conferred by previous vaccination

Intra-epidermic Vaccination.—This practice has recently been advocated The *technique is exactly similar to a Schick test A sterile needle, held almost parallel to* the skin, is inserted through a drop of lymph into the epithelial layer for about a twelfth of an inch *It is claimed that the method is simple, rapid, efficient, and economical* No dressing is required until the vesicle appears, and severe local or constitutional disturbances are said to be very rare There is also a great saving in the amount of lymph used, and this is an important factor when in an emergency a large number of vaccinations are required with a limited amount of lymph available

CHAPTER LXVIII

THE TREATMENT OF ACUTE POISONING

By H L Marriott

Serious cases of acute poisoning are desperate emergencies, there is not a moment to lose Because of the urgency of the situation it is necessary that the house surgeon confronted with a case of acute poisoning should be equipped with a clear knowledge as to what to do and how to do it

The subject of toxicology is usually presented in relation to each of the individual poisons considered in turn For each poison the symptoms are detailed and the treatment indicated Since there are very many poisons, the reader is apt to gain the impression that the subject is complicated, and he tends in consequence to feel that he can never hope to remember indefinitely what to do except in regard to the commonest poisons

This chapter will present the treatment of poisoning in regard to poisons considered *as a whole* Principles of treatment will be laid down which are applicable to *any* case of poisoning whatever, even if the nature of the poison is unknown To apply these principles, all that must be known is (1) That the case is one of poisoning, (2) The route of entry of the poison, (3) The chief effects which the poison is producing in the particular patient

1 That the case is one of poisoning is almost always indicated immediately to the doctor by those who summon him or who bring the patient to him In an experience of several hundred cases of acute poisoning, the author can only recollect two in which this was not true It is, however, important to remember that, rarely, a case of acute poisoning may not be presented as such Poisoning should be suspected in instances of inexplicable coma or intense vomiting or diarrhœa In any case of coma due to poisoning, there may be sugar, albumin, or blood in the urine, and there may be an extensor plantar response

Although the fact that the case is one of poisoning is almost always clear, yet it is not unusual for the precise nature of the poison to be unknown The patient may have inadvertently swallowed some household substance of unknown composition, or he may have been seen to drink from a bottle which is now empty, or he may have been found beside an empty bottle or glass This difficulty does not matter from the point of view of the general principles which are about to be stated They are framed to overcome it, and in the rest of this chapter very few poisons will be mentioned by name

2 The route of entry of the poison is also usually communicated to the doctor If there is any doubt about it, the assumption should be that the poison has been swallowed

3 The effects of lethal importance produced by poisons are usually immediately manifest, as will be explained later

In the following pages the principles and methods of treatment will be discussed in detail. At the end of the chapter they are compressed into a short summary, which conveys the essentials of treatment in *any* case of acute poisoning, and which is all that need be memorized

The aims of immediate treatment of any case of acute poisoning are two only (I) Removal of the poison from the body if this is possible, or, if not, its conversion into an inert form, (II) Counteraction of such effects of the poison as are immediately endangering life

I. REMOVAL OR NEUTRALIZATION OF POISONS

In the vast majority of cases poisons enter the body by being either inhaled or swallowed It is very uncommon for introduction into the body to be by unusual routes, such as injection, through the skin or wounds, or via the rectum or uro-genital tract

Inhaled Poisons.—Inhaled poisons are put first because of the great frequency of carbon monoxide poisoning, which in Great Britain and America causes more deaths than all other poisons combined

Removal of gaseous poison is essentially a matter of inducing a great increase in breathing, so that the poison can be washed out of the system The promotion of increased breathing is most effectively achieved by inhalation of 7 per cent of carbon dioxide mixed with 93 per cent of oxygen The breathing, owing to the stimulation of the respiratory centre by the carbon dioxide, is greatly increased *within a minute or two*

Administration of the carbon dioxide and oxygen mixture is most simply achieved by use of an ordinary bag and face-piece, as used for nitrous oxide administration The mixed gases are obtainable in cylinders In carbon monoxide poisoning* the use of carbon dioxide and oxygen inhalation has enormously reduced mortality, and it is almost true to say that no carbon monoxide case should die if treated before life is quite extinct

The inhalation of carbon dioxide and oxygen cannot take place if the patient's air-passages are obstructed, or if breathing has ceased or has almost ceased Obstruction of the air-passages and depression of respiration are common in gas poisoning Hence in such cases, clearance of the airway and the application of artificial respiration may be essential preliminary measures

The airway may be obstructed from falling back of the patient's tongue in unconsciousness, or from the presence of aspirated fluid in the trachea and bronchi Obstruction from prolapse of the tongue may be relieved by pulling the patient's tongue or jaw forwards. If traction is made on the tongue, it should always be gentle, and care should be taken that the organ is not injured by dragging it over the lower teeth If traction is rough, very serious swelling of the tongue may follow within a few hours When an instrument is used to pull upon the tongue, *it should be a tongue clip or safety-pin and never crushing forceps*

When the air-passages are obstructed by fluid, it is necessary to turn the patient into the prone position and to raise the pelvis, so that he is sloping head downwards The fluid can then run out by gravity

Artificial respiration is described in Chapter II In acute poisoning Schafer's method is desirable because of the advantages of the prone position

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* In suspected cases a diagnosis may be made by spectroscopic examination of the blood. A very dilute solution of the blood is made with distilled water This solution has a bluish red or cherry-red tint in contrast to the yellowish-red colour of a similar dilution of oxyhæmoglobin The spectrum of carboxyhæmoglobin (CO-Hb) shows two bands closely resembling in position and character the corresponding ones of oxyhæmoglobin, but the bands of the former are distinguished by the fact that they are *not altered by the addition of a few drops of ammonium sulphide*, whereas those of the latter are changed to the single band of 'reduced' hæmoglobin (*see* p 46)

The removal of inhaled poisons, summarized in tabular form, thus consists in —

a Maintenance of the patient's airway } when needed
b Artificial respiration }
c Administration of a mixture of 7 per cent of carbon dioxide and 93 per cent of oxygen to all cases

In carbon monoxide cases administration of the carbon dioxide and oxygen mixture should be maintained until the patient is thoroughly recovered These patients tend to relapse, and the medical attendant and the nurse must be ready to reinstitute treatment for a period of twenty four hours

Swallowed Poisons —The removal of swallowed poisons is best achieved by washing out the stomach Emetics should only be used if a stomach tube is not available Gastric lavage must be very thorough At least two gallons of water should be used, a pint at a time, so that the stomach is washed out again and again and no poison whatever left behind Lavage with one or two pints may be useless, because enough poison to kill the patient may remain in the stomach

Gastric lavage should never be omitted because the patient has vomited or because some hours have elapsed since the poison was taken If a patient has swallowed poison the stomach should be washed out, even if he seems perfectly well

The only swallowed poisons in which lavage or emetics are contra-indicated are the corrosive acids and alkalis, because of the danger of perforation These corrosives are the strong acids (sulphuric, nitric, and hydrochloric) and the strong alkalis (caustic soda, caustic potash, and strong ammonia) Carbolic acid, carbolic disinfectants, and oxalic acid are corrosive, but not sufficiently so to make gastric lavage dangerous

In the author's opinion the neutralization of the corrosives constitutes the only instance in which swallowed antidotes are of much practical importance In the case of all the other swallowed poisons, complete removal of the poison by thorough lavage is of more importance than theoretical attempts to render it inert Precious time may be lost before the commencement of lavage through fussing over the question of an antidote

It is not implied that neutralizing antidotes are completely valueless, but that they are of minor importance A list of them will be found on p 487 In a particular case, if the antidote is instantly at hand, it may be administered, added to the water used for the wash-out No time, however, should be wasted over it if it is not readily available

Technique of Gastric Lavage —The apparatus required for gastric lavage is as follows —

1 A Jaques' rubber stomach tube For adults the tube should not be less than ½ in in diameter, i e, Nos 23 to 30 of the English catheter gauge These tubes are commonly made either 30 to 60 in in length The longer tube is preferable, as it obviates the necessity for the interposition of a glass connexion and further tubing For children of 2 years and under, No 15 is convenient Stomach tubes used for gastric lavage should be fairly stiff, as too flexible tubes are difficult to introduce Before the tube is passed, the distance to which it should be passed should be marked by the insertion of a safety-pin through the wall, but not the lumen, of the tube For adults the pin should be inserted 20 in from the tip of the tube, for infants of 2 years or less, 10 in Before lavage the tube is

passed so that the safety-pin lies just outside the lips During lavage the pin provides a convenient indication that the tube is being maintained in position

2 A funnel of enamelled iron or glass
3 Two mouth gags
4 A tongue clip or a large safety pin
5 Two jugs, preferably of 1-pint and 4 pint sizes
6 A pail
7 Several newspapers to spread on the floor

The most important consideration in washing out the stomach is to place the patient in a proper position He must be so placed that his respiratory tract is not liable to be invaded by influx of fluid from the mouth Whenever gastric lavage is performed, the mouth tends to fill with fluid vomited or regurgitated around the tube and also with saliva Unless the patient is in such a position that the mouth and pharynx are on a lower level than the larynx, the fluid must run by gravity into the larynx, trachea, and bronchi, the only safeguard is the cough reflex, and this may be abolished in cases which are comatose

Attempts to wash out the stomach with the patient in an unsuitable position, such as lying on the back or sitting up, produce in conscious patients great coughing and spluttering, while in unconscious patients immediate death from drowning or later death from bronchopneumonia may result

The best position in general practice for the patient is lying prone (*Fig* 528) on a couch, bed, or table, with the face projecting over its end and supported looking down towards the floor The operator sits or kneels on the floor while passing the tube In the prone position conscious patients experience only the discomfort of the passage and presence of the tube, without the addition of suffocation Struggling children should be wrapped round and round with a blanket pinioning the arms It is much easier to hold down a struggling patient in the prone than the supine position, quite apart from the fact that his fighting is less ferocious when he is not literally contending for his life

The patient having been placed in the prone position, any false teeth should be removed and gags inserted on each side of the mouth If possible, one assistant should be delegated to make the control of the gags his sole concern

The end of the stomach tube should be lubricated with glycerin or liquid paraffin and then passed into the mouth in the middle line till it touches the posterior wall of the pharynx The tube should then be pushed swiftly down the œsophagus into the stomach The distance to which it is to be passed has already been mentioned Introduction of the tube should be rapid, bold, but not rough, it is no use expecting conscious patients to swallow it

When the tube has been passed, tepid water should be poured through the funnel into the stomach When a pint has been introduced ($\frac{1}{4}$ to $\frac{1}{2}$ pint in children) it should be syphoned back by inverting the funnel into the pail The first pint should be set aside for possible subsequent analysis

The wash-out should continue, a pint at a time, until sixteen pints have been used The volume of the returned fluid should be checked at the end, to make sure that no fluid has been lost Loss of an appreciable quantity suggests perforation of the stomach, which would necessitate surgical intervention

Emetics—The only indication for the use of emetics is lack of a stomach tube The emetic which is most certain in action is apomorphine hydrochloride, of which $\frac{1}{10}$ gr administered by hypodermic injection will usually produce vomiting

within five minutes Other emetics are zinc sulphate, ammonium carbonate, or powdered ipecacuanha, the dose of each is 30 gr Convenient household emetics are a tablespoonful of salt or mustard powder An oral emetic should be administered in half a tumbler of warm water and drunk quickly

Neutralization of Corrosives —As has already been stated, the corrosive acids are strong sulphuric, nitric, and hydrochloric acids, the corrosive alkalis are caustic soda, caustic potash, and strong ammonia

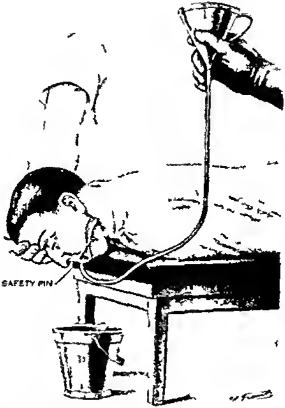

Fig 528 —Washing out the stomach For the sake of clarity the operator's hand holding the tube and the assistant's hand holding the gag are not shown The head must on no account be raised higher than shown.

The neutralizing agent should be administered in a pint of water (¼ to ½ pint in children), which serves to dilute the poison More than a pint may dangerously distend the corroded stomach For neutralizing the corrosive acids the best agent is magnesia (magnesium oxide), either mag ox lev or mag ox. pond , four tablespoonfuls of the powder should be used If magnesia is not readily obtainable chalk, soapsuds, whitewash, ceiling plaster, or washing soda may be used For neutralizing corrosive alkalis, 3 oz of vinegar or the juice of half a dozen lemons should be employed

Antidotes.—The following is a reference list of antidotes, with the amounts which should be added to two gallons of water. As has already been stated, they are, in the author's opinion, of minor importance.

Antimony	Tannic acid, 180 gr. (12 g.)
Arsenic	Add sodium carbonate to 2 fl. oz. of liquor ferri perchloridi till effervescence ceases. Filter, and use all the precipitated ferric hydroxide
Atropine	Potassium permanganate, 60 gr. (4 g.)
Barium salts	Magnesium sulphate, 2 oz. (60 g.)
Cocaine	Potassium permanganate, 60 gr. (4 g.)
Cyanides	Potassium permanganate, 60 gr. (4 g.)
Iodine	Thin starch paste
Lead salts	*Magnesium sulphate, 2 oz. (60 g.)*
Opium	Potassium permanganate, 60 gr. (4 g.)
Oxalic acid	Magnesium oxide, 4 oz. (120 g.)
Phenol	Magnesium sulphate, 2 oz. (60 g.)
Phosphorus	Copper sulphate, 15 gr. (1 g.)
Silver nitrate	*Salt, 2 oz. (60 g.)*

Poisons Entering the Body by Unusual Routes.—

Injected poisons cannot be directly removed or neutralized. If the patient is seen within a few minutes of the injection it may be possible, in the case of a limb, to prevent carriage of the poison to the rest of the body by the application of a sphygmomanometer cuff applied tightly enough to obstruct the venous return.

Poisons entering the body through the skin, wounds, rectum, or uro-genital tract should be removed mechanically by swabbing away or by lavage.

II. COUNTERACTION OF SUCH EFFECTS OF THE POISON AS ARE IMMEDIATELY ENDANGERING LIFE

Although there are many poisons, each with individual peculiarities of action, yet the modes of mechanism by which they produce death are few. This fact forms part of the foundation of this attempt to simplify the treatment of acute poisoning.

If all the poisons are considered in turn and their lethal effects analysed, there results a list of only five common modes by which life is primarily endangered. Stated in order of frequency these are: (1) Asphyxia; (2) Depression of the central nervous system, i.e., coma; (3) Dehydration and dechloridation; (4) Pain and shock; (5) Excitation of the nervous system, i.e., violent delirium or convulsions.

Often two or more of these effects occur together and react upon one another. From a practical point of view it is fortunate that, with the exception of some cases of asphyxia, all are instantly evident and require no diagnostic skill.

It will be noticed that circulatory failure is not included in the list. Circulatory failure is the almost invariable final cause of death in poisoning, but it is consequent upon one or more of the above effects and not due *primarily* to poisoning of the cardiovascular system. Later complications, such as bronchopneumonia, nephritis, and hepatitis, do not concern the question of immediate treatment.

Not only are the five primary lethal effects of acute poisoning readily recognized, but they are also very amenable to treatment. In fact, it is true to say that very few cases of acute poisoning should die if seen before they are moribund.

1. Asphyxia.—This is the most frequent cause of death from poisoning. Its treatment is so urgent that relief of asphyxia should precede even removal of the poison. For this reason the treatment of asphyxia will be found to be put first in the final summary.

CAUSES —Asphyxia may be caused by —

a Obstruction of the Patient's Air-passages—A common cause is obstruction of the glottic aperture by the tongue having fallen back in a supine comatose patient Œdema of the glottis may happen following the inhalation of irritant gases or liquids, but is a rare occurrence

Obstruction of the air-passages by fluid is relatively common The fluid may be (i) Inhaled vomit or saliva in unconscious patients, (ii) Inflammatory exudate, following the inhalation of irritant gases or liquids; (iii) Non-inflammatory transudate, when secondary circulatory failure is occurring

b Alteration in the Alveolar Epithelium—This may follow the inhalation of irritant gases or irritant liquids, and result in serious interference with the normal diffusion of oxygen and carbon dioxide across the epithelium

c Interference with the Capacity of the Blood to Carry Oxygen—The only important example of this class, but itself intensely important, is carbon monoxide

d Inadequate Respiratory Movements—This common cause of asphyxia in acute poisoning is generally due to toxic depression of the respiratory centre, and occurs notably in severe carbon monoxide poisoning and in poisoning by the many depressants of the nervous system It is also seen in severe poisoning by the irritant gases in the later stages Very rarely, inadequate respiratory movements are caused by spasm of the respiratory muscles, e g, in strychnine poisoning

DIAGNOSIS —Asphyxia should be diagnosed as being present in acute poisoning in all carbon monoxide cases and in all other cases with blue lips The nature of the breathing is an unreliable criterion, for it may vary from the most violent respiratory efforts (" fighting for breath ") to the feeblest gasps, depending upon the influences operating in the particular case

TREATMENT —The principles of treating asphyxia are simple —

a Maintenance of the patient's airway } when needed
b Artificial respiration }

c Administration of oxygen to all cases, with the addition of carbon dioxide to cases breathing feebly or due to gas poisoning

The principles are, in fact, the same as for the removal of inhaled poisons, and the practical details have already been discussed The best method for administration of oxygen or oxygen and carbon dioxide for short periods is by the ordinary nitrous oxide bag and face piece For longer administrations, the oxygen tent or nasal catheter is desirable (*See* pp 172, 173)

2. Depression of the Nervous System: Coma—The poisons which tend to cause coma are alcohol, the anæsthetics, the very many analgesic and narcotic drugs, carbolic acid and the carbolic disinfectants, and certain other poisons

Coma is usually accompanied by some degree of asphyxia, either from obstruction of the airway or from feeble breathing Conversely, severe asphyxia, as in carbon monoxide poisoning, so depresses the central nervous system that coma ensues

In practice, acute alcoholism is the most frequent cause of toxic coma Alcoholic coma may be quite deep when the patient is 'dead drunk' There is often a history obtainable that the patient has recently been drinking heavily The breath smells of alcohol The pupils are usually moderately dilated and react sluggishly to light A full bladder can often be palpated All cases of acute alcoholism that are in coma should be treated in hospital and not consigned to the police station until they have come round Such cases are seriously

poisoned Further, a case of coma from some other cause may often on first inspection appear to be due to simple drunkenness If the patient's coma is not deep, he may be left to sleep it off If, however, he is deeply unconscious, it is advisable to wash out the stomach and to institute the other measures for the treatment of coma which are about to be described

TREATMENT —In the treatment of toxic coma there are two drugs of pre-eminent value, namely, strychnine and coramine In regard to both it is desirable to administer relatively large doses, as the comatose patient tolerates and requires much larger doses than the patient who is not unconscious Injections of strychnine, $\frac{1}{8}$ gr hypodermically, and coramine, 5 c c to 15 c c intravenously or intramuscularly, should be administered immediately and repeated every one, two, or three hours according to the severity of the case

In toxic coma the intracranial pressure usually rises, and some of the poison is usually excreted into the cerebrospinal fluid For these reasons lumbar puncture is of value and should be performed immediately and at eight-hourly intervals thereafter as long as the coma continues The technique of lumbar puncture is described on p 392 The puncture should be controlled by a manometer, and the pressure of the fluid reduced, by allowing some to escape, until it is 120 mm with the patient in the lateral recumbent position

If coma is prolonged for many hours or days, the patient may become dehydrated from lack of fluid intake and from sweating Such dehydration is dangerous in itself and also because it has the effect of preventing urinary excretion of the poison The latter effect is very serious in barbiturate poisoning, since excretion of barbiturates occurs almost entirely by the urine Hence in all cases of coma prolonged beyond eight hours, continuous administration of fluid per rectum or intravenously should be instituted

The essential treatment of coma is thus —

a Strychnine, $\frac{1}{8}$ gr (8 mg) hypodermically, and coramine, 5 c c to 15 c c, intravenously or intramuscularly—administered at once, and repeated as often as hourly if necessary

b Lumbar puncture—immediately, and eight-hourly as long as the coma lasts

c. If coma is prolonged beyond eight hours—continuous rectal or intravenous saline

3. Dehydration and Dechloridation.—Many poisons produce intense vomiting and often severe diarrhœa The result is great loss to the body of water The loss may be so great that the patient may lose a stone in weight in a few hours In such cases water is not the only substance lost to the body There is also great loss of inorganic salts, particularly sodium chloride.

Dehydration and dechloridation produce the picture of collapse At first the patient complains of intense thirst and often of cramp in the limbs Later he becomes delirious and then comatose The skin is cold and clammy The subcutaneous tissues are lax, and in consequence the expression becomes sunken The blood-pressure falls and the pulse is rapid and feeble The output of urine becomes extremely scanty

TREATMENT —The remedy for dehydration and dechloridation is the administration of water and salt It must be realized that adult patients presenting the picture of dehydration have a fluid deficit of at least a gallon They therefore require this amount of fluid, plus the amount of fluid which is lost during the process of administration

Administration by mouth is best when practicable Even vomiting patients should be encouraged to drink freely, and the amounts ingested and vomited should be recorded, to determine if any fluid is being retained The best fluid for oral administration is half normal saline (i e , 0 425 per cent, or 40 gr to the pint) sweetened with glucose and flavoured with lemon or orange If the patient's condition appears to be serious, immediate intravenous administration of normal saline (0 85 per cent, or 80 gr to the pint) is necessary The saline should be administered by the continuous drip method, the technique of which is described in detail on p 80)

As has been stated, the dehydrated patient's requirement of fluid is considerable At the same time, waterlogging must be avoided, and observation should be kept for the development of œdema, particularly in the lung bases It is desirable to establish a urinary output of not less than half a pint, or 300 c c, every six hours In comatose cases a catheter must be kept in the bladder

4 **Pain and Shock** —Pain in poisoning is met with principally in poisoning by the corrosive acids and alkalis, the gastro-intestinal irritants, the irritant gases, and strychnine In corrosive poisoning the pain is so intense that it alone causes a considerable degree of shock, although probably the principal factor in the production of collapse is dehydration and dechloridation from the incessant vomiting

TREATMENT —Pain should be relieved by an immediate injection of at least ¼ gr (16 mg) of morphia

5 **Excitation of the Nervous System Violent Delirium or Convulsions** —A number of poisons act principally as deliriants or convulsants, but with the exception of alcoholic delirium tremens, such states arising from acute poisoning are rarely encountered in practice Neither delirium nor convulsions present any difficulty in diagnosis—they are only too obvious Delirium indicates a cerebral effect Convulsions, however, may be due to cerebral, medullary, spinal, or even muscular stimulation, depending upon the site of action of the particular poison involved

TREATMENT —Recent developments in the use of barbiturates have caused a great advance in the treatment of delirium and convulsions due to poisoning Different workers have used different barbiturates, but all have testified to their efficacy In the treatment of maniacal or convulsed patients it is necessary to use larger doses than are employed to obtain basal anæsthesia in normal individuals

In the writer's experience pernocton has been extremely satisfactory Pernocton is a 10 per cent aqueous solution of the sodium salt of the secondary butyl brom allyl barbituric acid It may be administered intravenously or intramuscularly The intravenous route has the advantage that quicker action is secured and the dose may be directly regulated by the effect produced The disadvantage of this route lies in the difficulty of intravenous injection with a violent or convulsed patient The intravenous injection should be given, drop by drop, at a rate not exceeding 1 c c per minute as timed by a watch, until the patient has passed into a quiet sleep From 2 to 8 c c may be required, depending upon the body-weight of the patient and the intensity of his excitation If the intramuscular route is employed, 1 c.c per 20 lb of body weight (as determined by rough guessing of the patient's weight) should be administered, If this amount is not effective within a quarter of an hour, half the original dose should be injected

The pernocton sleep usually lasts for several hours If the patient becomes violent or convulsed upon awakening, a fresh injection may be given

SUMMARY OF THE TREATMENT OF *ANY* CASE OF ACUTE POISONING

The practitioner should put the following three questions to himself and act instantly upon the answers evoked —

I —Is the Patient Asphyxiated or Suffering from Poisoning by a Gas ?

If so *a* Maintain airway } if
b Artificial respiration } needed
c 7 per cent carbon dioxide and 93 per cent oxygen for all cases, except non gas cases which are already breathing more vigorously than normal, who need oxygen only

II —If the Poison was not Gaseous, how did it Enter the Body ?

If swallowed Gastric lavage, unless it is known to be a corrosive acid or alkali

If corrosive Neutralize

Other routes Wash away poison if practicable

III —Is Life Endangered by any of the Four Following

1 *Coma ?*

If so *a* Strychnine $\frac{1}{8}$ gr (8 mg) hypodermically and coramine 5 to 15 c c intravenously or intramuscularly—at once, and repeated as often as hourly if necessary
b Lumbar puncture—immediately, and eight hourly as long as coma lasts
c If coma prolonged beyond eight hours—continuous rectal or intravenous saline

2 *Dehydration and Dechloridation ?*

If so Water and salt until relieved—half normal saline by mouth if practicable, or, if not, normal saline by intravenous drip

3 *Pain ?*

If so Morphia $\frac{1}{4}$ gr (16 mg) for an adult

4 *Delirium or Convulsions ?*

If so Injection of pernocton—either 1 c c per minute intravenously till patient sleeps, or an intramuscular injection of a dose of 1 c c per 20 lb of body weight

CHAPTER LXIX

THE ORDERING OF SPLINTS AND OTHER APPLIANCES

By F W Veale

When measurements are to be taken, the patient should be lying down and completely relaxed, with the arms lying limply by the sides The latter is an important point when taking measurements from the axilla When encircling a limb or a trunk do not draw the tape measure too tightly It is essential at

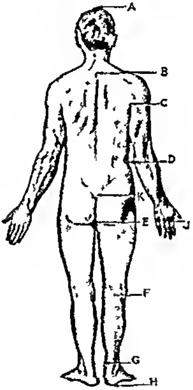

Fig 529—Illustrating the points at which measurements are made for the ordering of various splints and other appliances (*See text*)

all times for the measure to lie evenly along the skin surface, twisting and failure to take the shortest route between the given points will, of course, vitiate the measurement

In relevant cases it must not be forgotten to state whether the apparatus is for the right or left side

For Crutches.—

Length from the top of the axilla to the ground (C to H)
Length from the axilla to the grip of the hand (C to J)

For a Thomas's Knee Splint.—

Horizontal circumference of the thigh at the perineum (E)
From the perineum to the plantar surface of the heel (E to H)

Note particularly When ordering a knee-splint or calliper the circumference of the limb at the level of the perineum should be taken in the horizontal plane only It should be left to the instrument maker to judge the amount of obliquity and the extra size of the ring necessary

For a Knee Cage (Jointed)—State whether for left or right knee, the degree of movement required, and the amount (if any) of limitation from full extension Tracing taken down each side of limb extending to about 7 in above and 6 in below mid-patella Measurements —

Circumference of limb 7 in above mid-patella
Circumference of limb 3 in above mid patella
Circumference of limb at mid patella
Circumference of limb 3 in below mid patella
Circumference of limb 6 in below mid-patella

For a Walking Calliper—The same measurements as for a Thomas knee-splint The patient's boot must be sent to the instrument maker in order to have the tube fittings added to the heel

If the calliper is to be jointed, the length from the perineum to the centre of the knee-joint (E to F) must be given

If the calliper is to have a moulded corset top the circumference of the thigh taken 4 in below the perineum must be given

For Thomas's Hip Splint (Single) —

Circumference of the thorax (C)
Circumference of the thigh (E)
Circumference of the ankle (G)
Length from the axilla to the malleolus (C to G)
Length from the perineum to the malleolus (E to G)

For Abduction Frames for the Lower Limb.—It must be stated whether the abduction frame is to be single or double, and if single, whether it is the right or the left side which is to be abducted The measurements are the same as for the Thomas's hip splint If it is necessary to cut away a portion of the frame in the vicinity of a wound this must be shown clearly, preferably with a diagram

For a Spinal Frame.—Again the same measurements as for a Thomas's hip splint are taken If a head-piece is required, it is necessary to include the measurement from the top of the head to the axilla (A to C)

For a Spinal Support (Posterior Type) —

From the 7th cervical vertebra to the coccyx (B to K)
Circumference of the thorax taken at the top of the axilla (C)
Circumference of the waist (D)
Circumference at the tip of the coccyx (K)

If there is a deformity of the spine, a strip of 1-in wide lead tape is pressed on the spine, and will retain the correct contour The tape is then placed on its side on a piece of paper and a pencil tracing taken

For a Spinal Collar —State if it is to be used with a posterior spinal support or to be worn independently

Circumference at the base of the neck
Depth of front, taken from the point of the jaw to the sternal notch
Depth at back as required in accordance with the nature of the injury

For a Sacro-iliac Support —State whether required for a male or a female, in order that perineal straps or suspenders can be fitted

Circumference of the waist (D)
Circumference at the tip of the coccyx (K)
Depth from the waist to the coccyx (D to K)

State whether a pad is required over the joint to supplement fixation

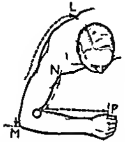

Fig 530 —Measurements required for an abduction splint for the upper limb

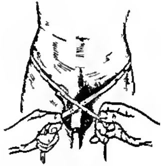

Fig 531 —Measuring for an inguinal truss

For an Arm Abduction Splint (*Fig* 530) —

Length from the spine to the point of the elbow (L to M)
Length from the anterior axillary fold to the fold of the elbow (N to O)
Length from the fold of the elbow to the centre of the hand (O to P)
Circumference of the thorax
Circumference of the waist
Length from the axilla to the top of the thigh when sitting

For a Truss for an Umbilical Hernia —The circumference of the body is measured at the umbilicus The size of hernia must be stated

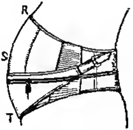

Fig 532 —Measurements for an abdominal belt

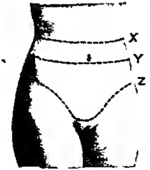

Fig 533 —Measurements for a colostomy belt.

For a Truss for an Inguinal Hernia (*Fig* 531) —The circumference 2 in below the crest of the ilium is taken The tape measure passes over both inguinal rings and meets at the os pubis The size of the hernia must be stated, and whether left, right, or both

For an Abdominal Belt (*Fig* 532) —

Circumference just below the waist (R)
Circumference at the umbilicus (S).
Circumference over the hips (T)
Depth of front (R to T)

For a Colostomy Belt —The following measurements are required (*Fig* 533) —

Circumference at the waist (X)
Immediately below the umbilicus (Y)
The measurement exactly as for an inguinal hernia (Z) (*see Fig* 531)

Also indicate the depth in front, i e , the measurement from the lines X to Z in the middle line The position of the stoma should be shown in a diagram, and its distance from the umbilicus measured The cup should be ordered as either large or small In cases where the fæcal matter is of a solid consistency or the amount small, a cup only is necessary (*Fig* 534) When there is little control the cup and bag type of receiver is recommended When practicable, the measurements should be taken with the patient standing

Fig 534 —A colostomy belt with cup

For a Suprapubic Belt —The circumferences at Y and Z (*Fig* 533) are required The distance from the suprapubic opening to the upper part of the symphysis pubis should be given, and also the size of the opening, so that the maker can recommend a suitable type of container

For Surgical Boots —It is preferable for the surgical bootmaker to obtain the measurements himself If this is impracticable, the surgical bootmaker should be consulted, when a comprehensive list of measurements, and directions for obtaining them will be furnished A fitting of the boot in its rough state is desirable

CHAPTER LXX

MEDICO-LEGAL REPORTS

By D C Norris

The house surgeon is often asked to furnish a report about a case under treatment at the hospital He should make sure before doing so that the patient consents to this—some hospitals have a rule that no such report may be given until a form is filled in and signed by the patient, giving his authority for the disclosure of the facts of the case (which are, of course, confidential) It is often required that the fee should be paid in advance

Workmen's Compensation Acts—The Acts provide that when a claim is made by or on behalf of an injured workman, the employer shall have a right to have the workman examined at all reasonable times by the employer's doctor, the workman has a right to require that his own doctor should be present at such examination, but the employer is not bound to pay a consultation fee, the workman cannot insist on his solicitor being present, or on the examination taking place at a solicitor's office In certain circumstances the employer may require a certificate to enable him to reduce or terminate payment of compensation, when the workman is no longer disabled, or when the disability is no longer due to the accident, the doctor is then obliged to state the grounds on which he forms his opinion This should be done as briefly as possible, consistent with clarity, for example —

1 In cases of full recovery "I find no signs of disability"

2 In cases of partial recovery "I find no signs of disability for light work."

3 In cases in which disability persists, but is held to be due to causes other than the accident "I find no signs of disability due to the accident"

If such a certificate has been served on the workman by his employer, a period of ten days is allowed for the workman to serve a counter-certificate from his own doctor, if the latter disagrees with the opinion expressed, such a counter certificate should likewise set out the grounds on which the workman's doctor differs in his opinion from the employer's doctor

Arrangement of Reports—Insurance companies sometimes send a printed form, with a request that the doctor will complete this by entering answers to a series of questions This form of report is particularly useful in life assurance examinations, and other cases in which presumably healthy persons are to be examined, but in cases of injury or illness it is usually better for the doctor to construct his own report, in which irrelevant material can be omitted, and the salient features of the case given their proper emphasis It makes for clarity if the matter is arranged under cross headings, such as History of Accident, Previous Medical History, Present Complaints, Condition on Examination, and Opinion *Diagrams are often useful, to illustrate loss of amputated parts, restriction of movement in joints, size and position of scars, and outline of fragments in cases of fracture* If separate documents are to be sent—e g, prints of radiographs,

copies of pathological reports, etc —it is advisable to give a list of these in a covering letter, in case they should become mislaid *Original documents, e g , X-ray negatives, reports signed by the pathologist, etc , should not be sent out of the hospital , care should, however, be taken that copies are accurate and legible, and include the full name of the patient and the date of examination*

Doubtful Cases.—
The house surgeon may be in doubt as to some important aspect of the case, e g , whether the condition found is due to the accident, or as to the diagnosis Such doubts should, if possible, be resolved before a report is sent, but in no case should they find expression in a vague or ambiguous report If the difficulty is such as could be resolved by some further tests or observations, then these should be undertaken if possible, or at least should be indicated in the report Thus, it is unsatisfactory to say, "He is making a good recovery, although the fracture has not yet healed soundly " , the doctor should suggest a further examination at such a time as would probably enable him to give a final opinion as to whether bony repair has been secured or not It is useless to report that a patient is "either a malingerer or a neurotic"—a definite opinion should be expressed, *giving the grounds on which this is formed, or some further tests suggested* which would resolve such a doubt If information is then provided that the patient has been seen to engage in a strenuous game, it would be justifiable to report "In view of the information furnished by you, and of my own examination of this case, I am of the opinion that A B is fit to resume his ordinary work"

The Doctor in the Witness Box.—If a case is taken to Court, the doctor may be asked to attend and give evidence Sometimes this request is made informally, as by a telephone message or letter, which the doctor is at liberty to disregard if he so desires, although courtesy would suggest that he should say so if he does not wish to be called as a witness His attendance at Court may be enforced by handing him personally a document called a 'Subpœna', which is an order of the Court, and which cannot be disregarded without making the doctor liable to proceedings for 'Contempt of Court', which might entail a fine or even imprisonment The service of a subpœna should be accompanied by *an offer of 'Conduct Money'—usually one guinea—which is intended to* pay the witness's travelling expenses to the Court Once the doctor has accepted the subpœna and the conduct money, he is bound to go to Court, but he need not give evidence unless his fees for doing so have been paid If this has not been done, he should say so to the Judge before taking the oath , once this has been taken the witness is bound to give evidence, whether he has received his fees or not, and some excuse may afterwards be made for not paying him —e g , the client's lack of means

Although the witness swears to tell "the truth, the whole truth, and nothing but the truth", this phrase has a narrow, technical meaning Actually, he will seldom be allowed to tell all he knows, but only to answer questions briefly—usually by saying "Yes" or "No" to the questions set by Counsel These questions are often very skilfully devised, so that while the doctor is led to reply to each question quite correctly, the general inference which Counsel seeks to draw from the whole series of answers may be very different from the true opinion of the witness If a doctor thinks he is being unfairly treated, or that a wrong construction is being put on his evidence, he should say so to the Counsel calling him, or in the last resort he may make a protest to the Judge It is a bad mistake to lose one's temper in the witness box , this is likely to lead to one's evidence being discredited

The rules of evidence exclude not only everything which is irrelevant, but also all that is 'inadmissible', such as hearsay , thus a doctor will not be allowed

to quote the observations of an eminent consultant with whom he saw a case, although such an opinion might be most important, and quite clearly relevant, the proper way to bring in such evidence is to call the consultant himself as a witness

When he attends Court, the doctor should remember that he is at the service of justice, and should place himself unreservedly in the hands of Counsel, who is an officer of the Court, and should do to the best of his ability what is required of him He should not be offended if the case turns out to be such that medical evidence is of little or no value, so that he may spend a good deal of time at Court without being called upon at all to give evidence, he should console himself with the reflection that he is entitled to his fees whether he is put into the witness box or not, so long as he actually attends Court when summoned to do so

Preservation of Records—A doctor who sends a medico-legal report should always keep a copy of it, together with all correspondence relating to the case, as legal proceedings arising out of the case may continue for months or even years

CHAPTER LXXI

ASSESSMENT OF INCAPACITY

By H E Griffiths

In order to determine the period of incapacity for work following an accident it is necessary not only to have a thorough knowledge of the physical and mental effects of the injury, but also an understanding of the exact nature of the work

Incapacity for work may be due to a variety of different causes, the most important of which are —

Pain	may incapacitate		for any form of work
Tenderness	"	"	e g , a blacksmith—tender palm
Loss of touch	"	"	dressmaker
Weakness	"	"	labourer
Loss of joint movement	"	"	acrobat
Loss of joint stability	"	"	steel erector
Deformity	"	"	soldier
Mutilation	"	"	waiter
Loss of agility	"	"	barge hand
Loss of dexterity	"	"	watchmaker
Loss of working speed	"	"	typist
Loss of special sense	"	"	policeman
Loss of power of concentration	"	"	bookkeeper
Loss of memory	"	"	teacher
Loss of confidence	"	"	barrister
Irritability	"	"	receptionist
Giddiness	"	"	scaffolder
Fear	"	"	night watchman

Physical and mental attributes required in different kinds of work include —

Muscular strength	by a	quarryman
Power of muscular endurance	"	timber porter
Manual dexterity	"	carpenter
Agility	"	professional cricketer
Speed of action	"	bottler
Muscle co-ordination	"	weaver
Self confidence	"	salesman
Power of concentration	"	costing clerk
Good memory	"	commercial traveller
Amiability	"	private secretary

The conditions under which work is performed may affect the ability to work For example, exposure to cold and wet may completely incapacitate a labourer with deficient circulation in one or more of his extremities, though the same man might be able to work quite satisfactorily inside a warm factory

"Nature is prodigal in her gifts", and in no occupation is physical perfection required, unless, perhaps, in that of an artist's model It follows, therefore, that capacity for work may be restored before full recovery from an injury has taken place

Table I—PROBABLE PERIODS OF INCAPACITY FOLLOWING OPERATIONS

OPERATION	PROBABLE PERIODS OF INCAPACITY IN WEEKS			
	Class 1 (Heavy)	*Class 2 (Light)*	*Class 3 (Highly Skilled)*	*Class 4 (Sedentary)*
For Inguinal hernia	12	6	6	6
Femoral hernia	16	8	8	6
Umbilical hernia	12	6	6	6
Ventral hernia	12–16	6–8	6–8	6–8
Varicocele	8	4	4	4
Hydrocele	8	4	4	4
Appendicitis	12	6	8	6
On Stomach	12–16	8	12	8
Gall bladder	12–16	8	10	8
Kidney	16–26	8–12	12	8–12
Spleen	26	12–16	12–16	12–16
Urinary bladder	12–16	8	8	8
For Ruptured urethra	8–10	6	6	6

Table II—PROBABLE PERIODS OF INCAPACITY FOLLOWING OPERATIONS FOR SUTURE OF NERVES

NERVE	PROBABLE PERIODS OF INCAPACITY IN WEEKS			
	Class 1 (Heavy)	*Class 2 (Light)*	*Class 3 (Highly Skilled)*	*Class 4 (Sedentary)*
Median	104 +	52 +	104 +	52
Ulnar	52 +	26	52	4
Musculospiral	78	26–52	52	26
Sciatic	104 +	104 +	*	*
External popliteal	52 +	26 +	*	*
Internal popliteal	52 +	26 +	*	*

* Not necessarily incapacitating for work but may interfere with travelling

Table III—PROBABLE PERIODS OF INCAPACITY FOLLOWING OPERATIONS FOR SUTURE OF MUSCLES AND TENDONS, ETC.

OPERATION	PROBABLE PERIODS OF INCAPACITY IN WEEKS			
	Class 1 (Heavy)	*Class 2 (Light)*	*Class 3 (Highly Skilled)*	*Class 4 (Sedentary)*
Suture of—				
Supraspinatus	26	13	16	6
Biceps	26	12	16	6
Extensor longus pollicis	12–16	12	16	3–12
Flexors of fingers	12	6–8	12–16	6–8
Extensors of fingers	8–12	6–8	8–12	6–8
Quadriceps extensor	12–16	8	6–8	6–8
Tendo Achillis	12–16	8	6–8	6–8
Removal of cartilage—				
Internal semilunar	12–16	8	6–8	6
External semilunar	12–16	8	6–8	6

Table IV—PROBABLE PERIODS OF INCAPACITY FOLLOWING FRACTURES

BONE	PROBABLE PERIODS OF INCAPACITY IN WEEKS			
	Class 1 (Heavy)	*Class 2 (Light)*	*Class 3 (Highly Skilled)*	*Class 4 (Sedentary)*
Clavicle	8–10	5	7	5
Scapula	10–12	8	10	6
Humerus, neck	20–26	12	20–26	12
„ *shaft*	16–20	12	20	8–12
„ supracondylar	16–20	12	20	8–12
Radius, head	8	6	8	4
„ shaft	12	8	12–16	8
Ulna, olecranon	12–16	8	12–16	8
„ shaft	8–12	6–8	8–12	6–8
Radius and ulna	12–16	10	20–26	10
Colles's fracture	10–12	6–8*	12*	6*
Scaphoid (carpal)	12–26	*	*	*
Semilunar (dislocation)	12–16	*	*	*
First metacarpal (Bennett)	10–12	6	12–16	6
Metacarpals	8–12	6–8	12–16	6
Phalanges	6–10	6	12–16	*
Pelvis	12–16	8–12	8–12	8–12
Femur, neck	—	26 +	12 +	12 +
„ shaft	39–52	16–20	16	16
„ *condyles*	39–52	16–20	16	16
Patella	16–20	8–12	8–12	8
Tibia, head	39–52	16–20	16*	16*
„ *shaft*	26–39	12–16	12*	12*
Tibia and fibula, shafts	26–39	12–16	12*	12*
Malleolus, including Pott's fracture	16–26	10	10*	10*
Fibula, shaft	6–8	4	4*	4*
Astragalus	20–26	12–16	12*	12*
Os calcis	26–104	26–52	26–52*	26*
Metatarsals	12–20	8–12	8*	8*
Phalanges—				
Great toe	8–12	6–8	6*	6*
Other toes	4–6	3	3*	3*
Vertebræ—				
Bodies				
Cervical	20–26	10–12	26	10–12
Thoracic and lumbar	39–104	26–52*	26–52*	26–52*
Pedicles	39–104	26–52*	26–52*	26–52*
Spinous processes				
C 6, 7 and D 1 (digger's fracture)	3–6	3*	3*	3*
Dorsal and lumbar	8–12	6–8	6–8*	6–8*
Transverse processes (lumbar)	8–12	6–8	6–8*	6–8*
Sacrum	26–39	12–16	12–16	12–16
Coccyx	8–12	6	6–12	6–12
Mandible	8–16	8*	8–12*	8*
Ribs	8	3	4–6	3*
Skull†				

* After immobilization of the fracture with plaster of Paris or otherwise the patient may be able to return to work before union has been secured.

† Details in fractured skulls cannot be given because the incapacity is due entirely to the brain injury, which varies very considerably in different cases

The task of the determination of capacity for work after injury is that of an estimation of the restoration of function in relation to the requirements of the work For example, in the case of a labourer who had a fracture of the femur two years ago which is now firmly united with one inch of shortening, capacity for work will depend on whether he is relatively free from pain, whether the limb is strong and supple, whether there is sufficient joint movement to allow him to bend and pick up loads and to climb ladders, whether his joints are sufficiently stable to give him a sense of security when working on scaffold boards, etc The fact that he may have a slight limp from the shortening of the leg is not an indication of incapacity, the fact that he may have about 15° loss of flexion of the knee joint is not evidence of incapacity If, on the other hand, the man had been a waiter instead of a labourer, the limp caused by the shortening would probably prevent his resuming work in his old trade

In *Tables I–IV* (pp 500, 501) an attempt is made to give a rough guide to the periods of incapacity which may be expected after certain injuries or operations in otherwise uncomplicated cases For example, it is assumed that the patients are able to get proper nourishment and that they are not obsessed with thoughts of compensation or litigation

Four general classes of work are considered —

1 Heavy manual work

2 Light manual work, i e, work which, having regard to the age, sex, and physique of the patient, places no great strain on the muscular system either by the employment of sudden force or by prolonged usage

3 Highly skilled manual work, i e, work requiring considerable training in order to acquire the necessary dexterity, e g, watchmaking, typing

4 Sedentary work of the office type

Operations on Nerves—In the hands of the expert a fairly high percentage of successes may be obtained after immediate suture of divided nerves, but under present conditions in the treatment of industrial injuries delayed suture is more frequently seen, and less than 25 per cent of cases are successful *Table II*, therefore, can only be considered as a guide to those cases in which suture proves successful

CHAPTER LXXII

THE HOUSE SURGEON AND THE NURSING STAFF

By Dame Ellen Musson

Close co-operation between the Medical and Nursing Staff is essential if the full benefit of medical or surgical treatment is to be attained To prescribe such treatment is the duty of the Medical Officer It is the province of the Sister to see that his orders and directions are skilfully carried out and the patients efficiently nursed The general management of the ward or department is also her responsibility

In no place is the maxim that ' manners makyth man " more true than in a hospital Courtesy and consideration when shown to each other by the Medical and Nursing Staffs lead to loyal co-operation, and help to maintain the happy and peaceful atmosphere which is necessary for the patients' complete recovery A domineering autocratic bearing with an absence of good manners has the reverse effect

Punctuality on the part of everyone is necessary to the smooth working of the complicated machinery of a hospital and of the hospital wards No Resident Medical Officer can expect smooth working conditions if he ignores this fact and is erratic and unreliable in the performance of his duties

A nurse, by reason of her continuous attendance on the patients, has greater opportunities for detailed observation than has the Medical Officer in his periodic visits Many nurses thus acquire something which almost amounts to ' instinct ' in regard to their patients An experienced Ward Sister is able to help a Resident Surgical Officer not only by her knowledge of the methods most favoured by the Visiting Medical Staff and by her knowledge of the idiosyncrasies of individual patients, but also by reason of this acquired ' sense ' which often warns her of changes in a patient's condition before such are apparent to a newly qualified Medical Officer A wise man who takes advantage of his opportunities when holding a hospital post and works in close and friendly collaboration with the Sisters will often reap great benefit from their riper experience

CHAPTER LXXIII

HOSPITAL ADMINISTRATION

By H H MacWilliam

The out-patient who said to the house surgeon "It is the likes of me what put that white coat on you" spoke with a measure of truth The hospital exists for the sake of the patients This should be the guiding principle of the medical administrator, who must also remember that he is primarily a doctor

The Medical Staff—The reputation of a hospital depends more upon the acumen of its staff than any other single factor An imposing building, latest equipment, and elaborate special departments are excellent attributes, but they are of secondary importance in consolidating a hospital's reputation It is the duty of the administrator to promote harmonious association and co-operation among the staff An atmosphere of goodwill and loyalty and the absence of jealousy and excessive rivalry indirectly results in the efficient treatment of the patients Each member of the staff should be given his due position and demarcation of function, so that there can be little opportunity for one member to encroach on the sphere of another If misunderstandings arise, the administrator should arbitrate

In general, responsibility should be placed where it properly lies, and credit for achievement should be distributed similarly Most individuals do their best work when they act on their own volition, and as long as this does not interfere with the work of others, freedom of action should be allowed It is too much for every member of the staff to expect to do as he likes, but at least he should like what he is doing Energy and originality in the staff should be encouraged

It is often wise to introduce changes gradually, few administrative problems are urgent There should be full discussion of the whole staff on matters of general policy, and suggestions from any member should be given proper consideration Always, the aim in view should be to act in well-balanced unity

Contacts with the General Public—All members of the public coming to the hospital must be treated with consideration and courtesy Minor hospital officials must not be allowed to display the insolence of office, on the other hand they should preserve a certain dignity Jokes and levity are out of place, for they are liable to be misunderstood by outsiders

Letters must be answered promptly Copies should be made and filed with the case sheets, if the inquiry refers to a patient Care should be taken to spell names correctly, and if reference numbers have been given in letters they should be noted in the replies Letters to doctors about patients should give all the information that may be useful. If the diagnosis arrived at in the hospital differs from that made by the general practitioner, always remember that the facilities of the hospital make accurate diagnosis much easier Never yield to the temptation to crow over the mistake of a fellow practitioner

Admission of Patients—Every hospital has its own regulations about the classes of cases to be admitted and the areas from which they may be expected,

but all require that the patient who comes for admission should be attended to promptly Nothing damages the reputation of a hospital more than publicity concerning an ill person kept waiting unnecessarily

All the particulars required—name, age, address, religion, date, time, and so on, must be fully, accurately, and legibly recorded

The medical examination cannot be expected invariably to result in an exact diagnosis, but it should discover the category to which the patient belongs, so that be may be sent to the correct ward If a surgical case, handicapped with a medical label, is sent to a medical ward, a tragedy may result A fundamental point at this early stage is to recognize a really ill patient, and particularly if there is any need for immediate further professional advice In this connexion the hospital resident should not be too proud to take into consideration the opinion of the nursing staff Experienced sisters can often perceive better than a newly-qualified doctor whether a patient is gravely ill

'*Drunk or Dying*' This is a well recognized perplexity That the patient's breath smells of alcohol is no criterion If, after due deliberation, you come to the conclusion that the patient is inebriated, do not be content with writing on the record paper 'C_2H_5OH', record all the observations which led you to the diagnosis

Infectious Cases If there is doubt about the diagnosis, consult with a colleague before the patient leaves the receiving room By taking this precaution the spread of infectious disease may be prevented

The house surgeon who refuses to admit a patient frequently assumes heavy responsibility The usual excuse for refusing a case is shortage of beds It is difficult to believe that any hospital worthy of the name cannot make a bed for such a case as a perforated duodenal ulcer or a patient with a tourniquet around his leg Transfer of such cases can seldom be justified If it appears likely that the patient cannot be admitted, it is much better to send him on at once, after conducting an examination in the ambulance, rather than to keep him waiting in the Casualty Department

Visiting.—Visitors disturb the work of a ward, and are sometimes regarded as a nuisance Nevertheless, it must always be remembered that the happiness of patients depends very much on the facilities for seeing their relatives and friends For ordinary patients who are not dangerously ill it is well to have a short period of visiting, say half an hour, every day An arrangement such as this can be fitted in the ward routine and causes less disturbance than long visiting hours, even if they are less frequent When a patient is dangerously ill the relatives must be allowed to come whenever they wish, but the time they actually remain with the patient must be regulated by the doctor or the sister-in charge, who will take into consideration the best interests of the patient

In the Wards.—An excellent method of judging the efficiency of a hospital is to inspect a representative group of case-sheets It is hardly possible to exaggerate the importance of the dated record and progress notes When a patient has been in hospital for a long time or suffers from chronic disease, it is a good standing rule to have recorded and initialed that the patient had been examined periodically, even if no new facts were discovered

Operations.—No operation may be performed without the consent in writing of the patient or, in the case of a child, the consent of its parents Persons over 16 are considered capable of giving consent In the case of minors, that is persons under 21 years of age, unless the condition is extremely urgent, authority must be obtained from a parent or guardian

This rule often causes considerable inconvenience because firstly many persons under 21 years of age lead lives of independence and are not in close contact with their parents, and secondly, the urgency or otherwise of an operation is sometimes a matter of opinion It is wise to adopt the form of permission suggested by the Medical Defence Union

A good case can be made for taking 16 as the critical age because the Ministry of Health Order 1930 covering the administration of Poor Law Hospitals, following long-established precedent, takes 16 as the age at which a person ceases to be a child, but the fact remains that a surgeon who accepts the signature of a person under the age of 21 must be prepared to defend his action

It is advisable to obtain the consent of the husband before performing an operation upon his wife, althought there is no obligation to do so unless the operation is one which might cause sterility or interfere with marital relations

Births—All births, both live and still, must be notified to the Medical Officer of Health The child is born alive if it breathes or shows other signs of life after separation from the mother If a period of gestation of less than 28 weeks results in a *dead* fœtus, the case is one of abortion or miscarriage The distinction formerly made between abortion and miscarriage has been abandoned

Maternity benefit under the National Health Insurance is paid in respect of all live births and for stillbirths after 28 weeks' gestation It sometimes happens that a feeble newborn child dies before it is seen by a doctor. In such cases it is wise to notify the Coroner, and to abide by his instructions

Mistaken identity of newborn babies is not unknown, and it is advisable to have standing rules designed to prevent such errors Before the child is removed from the labour bed a strip of adhesive strapping bearing the name should be attached to its skin As soon as convenient this is replaced by two labels in the form of tapes On each is written in marking ink name, religion, and date of birth One tape is placed around the ankle and the other around the wrist It is important to have *two* labels, in case one should become detached When the tape labels are fixed, the temporary strapping is removed, and the identity checked by a second nurse

Abortions.—There is little doubt that many abortions are induced by criminal action If the patient herself is at fault, it is no part of the doctor's duty to report the matter to the police, although the Coroner must be informed should she die If the abortion is known to be the work of a professional abortionist, the doctor who hides the fact carries a heavy responsibility, other lives are at stake He should persuade the patient to allow information to be given to the police Should the patient be in danger of death, it is of cardinal importance that a dying declaration be made, and the doctor who takes no steps to obtain this evidence may incur grave culpability

Attempted Suicide.—Attempted suicide is a crime The facts must be reported to the police Full contemporary notes must be made of all circumstances including the method of obtaining the drug or weapon The hospital may be at fault in allowing access to poisonous drugs In many instances the action of the patient can be attributed to a disordered mind and he can be transferred to a ward for the insane As a rule, if it can be avoided, the police are reluctant to take action

Dangerous Drugs—Narcotic drugs should be ordered only for the benefit of the patient, they should never be given for administrative or nursing convenience Orders for Schedule I drugs must be signed—initials are not sufficient.

Signing Certificates.—*In legal circles it has* been said that a doctor will sign anything, there are some grounds for this assertion All certificates should be read carefully to make sure that the statements certified are within one's knowledge, and are true A certificate is true only for the time at which it is signed, never certify to-day something which you expect will be true to-morrow Never sign blank certificates, leaving the blanks to be filled in by someone else A facsimile rubber stamp must only be used under the hand of the principal If it is for open use, the words 'per pro' must be embodied in the stamp

Discharge of Patients.—A patient must be allowed to take his discharge whenever he wishes to do so If he selects an inconvenient time an effort to persuade him to stay is permissible, but he cannot be compelled to give reasonable notice of his intention to depart unless the hospital is administered under the Poor Law If he is medically unfit to go, he should be asked to sign an acknowledgement that he is leaving against medical advice, but again it must be remembered that he cannot be compelled to sign such an acknowledgement If he refuses to sign, it is a good practice to have a witness that he has been advised, but refuses, to stay in hospital

Before discharging a patient it is necessary to see that all his notes are completed and in order A letter to the patient's doctor may be written at this time, but if this is not the custom of the hospital care should be taken that all the material required to answer an inquiry from the doctor is available Before discharge the patient should be reasonably fit to cope with the conditions he will meet outside The efficiency of hospitals is judged too often by the average length of stay of the patients, but this is not always a good criterion

Transferring Patients to other Hospitals.—Too often an urge to transfer a patient is not inspired by zeal for his welfare To transfer a patient is not an achievement—rather is it the admission of incapacity of some kind on the part of the hospital Every transfer is a potential source of dissatisfaction Complaints may come from the patient, his friends, or the receiving hospital It is common prudence *to refrain from transferring* a case which may place some member of the hospital staff in an unfavourable light, the hospital's dirty linen should be washed in the hospital's own laundry

If, after full consideration, a decision to move the patient is reached, make sure that proper arrangements are made for his transfer See that his relatives are given adequate notice, and, above all, pass on to the receiving hospital the information you yourself would expect to be given in similar circumstances

Deaths.—*In some hospitals it is the rule that a resident should be summoned* In large hospitals it is difficult to keep to this rule, and it is probably unnecessary It is essential that the sister should make a note on the case-sheet stating the date and the time of the death This entry must be signed The case sheet is then sent to the hospital administrative office, sometimes with a special death notification form From the office a notification is sent to the relatives

The body is left in the ward for an hour It is then washed and dressed in a shroud A card stating name, age, and religion of the deceased, with the date of death, is sewn on to the shroud A similar card is prepared for attachment to the mortuary shell As this arrangement does not prevent the risk of confusion when a post-mortem examination is performed, a name label must be attached to one ankle The body is then conveyed to the mortuary under the supervision of a nurse An undertaker should not be allowed to remove the body without the written order from the administrative office When the undertaker arrives,

the body is identified by a nurse after it has been placed in the coffin If a nurse is not available, identification must be furnished by a relative

An objectionable activity of some undertakers is the employment of touts to give early information of deaths These touts make efforts to bribe minor hospital officials, and they are very difficult to detect

Post-mortem Examinations.—It is to the benefit of all concerned that everything possible should be learnt about fatal cases The American Medical Association lays down a rule that, if the hospital is to be approved for intern training, post-mortems must be performed upon a minimum of 20 per cent of subjects

Permission for the post-mortem must be obtained from a near relative While not a legal obligation, failure to obtain permission leads to a great deal of unpleasantness If good reasons are put to the relatives with clarity and sincerity, more often than not consent is given One must be able to assure relatives that there will be no delay in issuing the death certificate or the removal of the body, and that there will be no discernible disfigurement The promises must be fulfilled meticulously

Medical Care of the Nursing Staff—Nurses and others on joining require a careful medical examination with a case-sheet similar to that used for patients The previous medical history must be recorded It is advisable to have a radiograph of the chest to exclude the possibility of incipient tuberculosis Those who have not had diphtheria should be given a course of immunizing injections, unless tests have shown them to be immune If they have not been vaccinated, this must be carried out Under the National Health Insurance regulations a nurse is under no obligation to select a doctor on the staff of the hospital as her panel doctor, although the convenience of the arrangement is so obvious that she generally does so If a nurse wishes to consult a doctor, she must be allowed to do so without the consent of a senior member of the nursing staff

CHAPTER LXXIV

CERTIFICATION OF DEATH AND REPORTING TO THE CORONER

By W Bentley Purchase

DEATH CERTIFICATES

A registered practitioner who has attended a patient in his last illness is required by law to certify the cause of the death " to the best of his knowledge and belief " When completing the form it is essential for the doctor to state when he last saw the deceased and whether he saw the body after death It is necessary to set out the cause of death clearly, and ambiguous terms such as ' syncope ', ' coma ', ' respiratory failure ', etc , must be avoided

The form provides for a main cause of death, and this is often sufficient, e g , carcinoma of the stomach It also allows a secondary contributory cause to be inserted, thus —

I (*a*) Intestinal obstruction , (*b*) *Carcinoma of pelvic colon (opn —colotomy)*
II Chronic bronchitis

The secondary or associated cause should be recorded only if it does really contribute to the death,

If a doctor for some reason notified a death direct to the Coroner, he should place his initials at the back of the certificate, and this will intimate to the Registrar that such notification has been given

REPORTING A DEATH TO THE CORONER

It must be appreciated that while it is a doctor's duty, if he can, to issue a death certificate, it is the Coroner's duty to inquire into certain deaths reported to him In theory it is permissible for a doctor to issue a certificate even in a case of death by violence, e g , ' cut throat ', but under these circumstances it is incumbent upon the Registrar of Deaths to refer the certificate to the Coroner Such a procedure only leads to delay , it is obviously more convenient to all concerned for the doctor to report direct to the Coroner or, more often, to the Coroner's officer The latter is usually a police officer In cases of doubt the local police station will always assist in getting in touch with the nearest Coroner

Once the Coroner is informed of a death, the entire responsibility of certification rests with him He may take one of three courses —

1 —*After inquiry, but without necropsy or inquest, decide that the death* resulted from natural causes in this case he gives permission to the Registrar of Deaths to accept a certificate issued by the doctor in attendance during the last illness

2 Make inquiry and order a necropsy (for which he pays), and on the findings (*a*) Issue a certificate himself , (*b*) Hold an inquest

3 Hold an inquest with or without a necropsy

Cases to be Reported to the Coroner —These are (1) Sudden (i e , unexpected) death—cause unknown (2) Violent or unnatural death, including

poisoning or suspected poisoning, overdosage of drugs, etc (3) Deaths of all lunatics (4) Deaths of all foster-children

'Unnatural' Deaths.—It is necessary to consider more fully the 'unnaturalness' of a death Deaths due to violence or accident call for no comment; nevertheless it must be understood that the passage of time has no bearing on the necessity for reporting to the Coroner A man may die from injuries received many years previously, but it is just as necessary to report the matter to the Coroner Although the lapse of time precludes a criminal charge, it makes not the slightest difference to the fact that death was due to unnatural causes

Unnatural deaths embrace those due to, or accelerated by, alcohol, drugs, self-neglect, or neglect by others Even old war wounds come under this category, thus it is important to realize that a death which is expected, and the cause of which is understood, does not necessarily become natural

War Casualties—Deaths (civilian and service) which result from war operations are subject to special temporary provisions They need not be reported to the Coroner unless there be some doubt as to the cause of death (as there well may be if there be no external indication, e g, blast injury of lungs), or unless there is reason to think that some cause other than war operations has led to the death (e g, coronary thrombosis during an air raid, or injuries sustained by a fall while seeking shelter in a raid)

Provision is also made for the deaths of persons killed in war operations and subsequently unidentified or wrongly identified, to be reported to and investigated by the Coroner, thus procedure extends to the cases in which no part of the body remains

Death during Anæsthesia or as the Result of Operation—An anæsthetic may not necessarily render a death unnatural, e g, a patient with intestinal obstruction may die on the way to hospital, in the lift up to the theatre, or on the table after the commencement of the anæsthetic Under such circumstances death may be natural and due entirely to the condition causing the intestinal obstruction

It used to be said that if a patient died on the operating table the fact should be communicated to the Coroner, whereas if death took place after the patient had once returned to the ward, no such notification was necessary This is entirely inaccurate The point to be decided is the cause of death, and the person to decide it is the Coroner on the information supplied to him

In conclusion, it is better to err on the side of reporting a case unnecessarily rather than to omit to do so In cases of doubt as to the cause of death, where relatives refuse a necropsy, the doctor cannot complete the certificate of death conscientiously If this matter is reported to the Coroner, he may arrange for a post mortem examination to be made at his order

Payment of Fees by Coroner.—By statute a doctor who makes a necropsy at the Coroner's order is entitled to two guineas if he gives evidence as well, he is entitled to three guineas, for giving medical evidence only, with no necropsy, the fee is one and a half guineas In a few districts the Coroner is empowered to pay a fee varying from 3s 6d. to 10s 6d to a doctor for providing a written report upon a case without necropsy or evidence in court

CHAPTER LXXV

DEATH CERTIFICATION IN SCOTLAND

By Sydney Smith

In Scotland the form of death certificate is simpler than that used in England and requires the doctor to state (*a*) the primary cause of death, and (*b*) the secondary causes, in order This certificate must be sent to the Registrar within seven days of the death *according to the law, but it is customary to hand it to a* relative of the deceased to take to the Registrar

In no circumstances should a death certificate be given in duplicate, nor should a certificate be signed in blank for the relatives to fill up Certificates should never be given —

1 Without personally seeing the body, even when the medical practitioner has been constantly in attendance

2 In any case where he has not been in attendance during the illness, even though he were present at the death

3 In sudden deaths from unknown causes

Death from an Accident.—When a person dies directly or indirectly from an accident, or when there is reason to suspect that death is not due to natural causes, a certificate may require to be given in England *and* the case reported to the Coroner In Scotland in any of these circumstances the Procurator Fiscal should be notified, and no death certificate should be issued unless authorized by him

If the practitioner has any reason to believe that there is any suspicion about the cause of death, it is his common law duty to inform the Procurator Fiscal, apart altogether from his duties as a medical practitioner

***Post-mortem* Examinations.**—No post-mortem should be performed in any case of accident or where there is any suspicion, without instruction from the proper authority Though the performance of such autopsy is not illegal (if without intent to impede or prevent subsequent investigation), it is most inadvisable, as it may hinder the proper administration of justice When once a case is in the hands of the judicial authorities it may not be examined in any way without authority

If there is doubt as to the cause of death and the relatives refuse to allow an autopsy the doctor may refuse to give a certificate of death

Unnatural Deaths.—In the investigation of sudden death or death from unnatural causes, the procedure in England and Scotland differs, inasmuch as in England a public Coroner's inquiry is held, whereas in Scotland the inquiry is of a private nature carried out by a legal official known as the Procurator Fiscal In either country, such an inquiry may lead to proceedings in various courts of law, and it is desirable that the medical man should have some knowledge of these

Death Under Anæsthetics or as a Result of Operation.—An anæsthetic may not necessarily render a death unnatural, e g, a patient with intestinal

obstruction may die on the way to hospital, or on the table after the commencement of the anæsthetic Under such circumstances death may be natural and due entirely to the condition causing the intestinal obstruction

It is sometimes said that if a patient dies on the operating table the death should be considered to be due to the anæsthetic, but that if death takes place after the patient has returned to the ward it should not be so attributed This is quite wrong The point to be decided is the cause of death, and the person to decide it is the Procurator Fiscal or the Coroner on the information supplied to him

It is better to err on the side of reporting a case unnecessarily rather than to omit to do so

Suicide.—Scottish Law is quite different from English Law with reference to suicide In English Law, suicide, or self murder, or *felo de se*, is regarded as a peculiar instance of malice directed to the destruction of a man's own life An attempt to commit suicide is a misdemeanour at Common Law, and is punishable by fine or imprisonment, provided that the accused was sane at the time of the attempt In so-called " suicide pacts ", if one of the parties survives and the other dies, the survivor may be charged with murder The doctrine of *felo de se* has never been part of the Law in Scotland, and an accessory to a suicide cannot be charged with any crime Nor is it a crime in Scotland to attempt to commit suicide, although the circumstances may lead to proceedings on a charge of " breach of the peace "

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JOHN WRIGHT AND SONS LTD PRINTERS AND PUBLISHERS, BRISTOL, ENGLAND